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Pharmacogical Potential And Bioactivity Of *Mangifera indica* L.: A Scopus-Based Bibliometric Analysis

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ABSTRAK

Introduction*: Mangifera indica* L. (mango) is a tropical plant valued in traditional medicine and rich in bioactive compounds such as mangiferin, quercetin, and catechin, known for antioxidant, anti-inflammatory, antimicrobial, antidiabetic, hepatoprotective, and immunomodulatory activities. Despite increasing research, no comprehensive bibliometric mapping of its pharmacological potential and bioactivity has been conducted.
Objective: To analyze global research trends, influential contributors, and thematic foci on the pharmacological potential and bioactivity of *Mangifera indica* L. using a Scopus-based bibliometric approach.
Method: Publications from 2015–2024 were retrieved from Scopus using defined Boolean search terms. Only English-language journal articles in the final publication stage were included, resulting in 305 records. Data were analyzed using Microsoft Excel 2021, Bibliometrix/Biblioshiny, and VOSviewer to evaluate performance indicators, thematic evolution, and network visualization of co-authorship, co-citation, and keyword co-occurrence.
Kesimpulan: Annual publications peaked in 2023 (n=50) and 2024 (n=54), showing growing scholarly interest. Industrial Crops and Products was the most influential journal, strongly linked to Molecules and Food Chemistry. CASAS L and MANTELL C were the most productive authors (7 articles each), while Ho Chi Minh City University of Technology led institutional output (47 articles). India was the most prolific country and a central hub for collaborations. Keyword mapping revealed two clusters: phytochemistry and bioactivity, and methodological advances. Research on *Mangifera indica* L. has expanded significantly in the last decade, bridging pharmacognosy, food science, and nanotechnology. However, gaps remain in translational research and clinical application.

Kata Kunci: *bibliometric analysis, bioactivity, mangifera indica l., pharmacological potential, scopus database*

Introduction

Mangifera indica L., commonly known as mango, is a tropical plant from the family Anacardiaceae that is widely distributed across Asia, Africa, and Latin America (Minniti et al., 2023). In addition to being a popular fruit commodity, mango has long been utilized in traditional medicine across various cultures (Awodele et al., 2015). Different parts of the plant, such as the leaves, bark, seeds, and fruit, contain bioactive compounds including mangiferin, quercetin, catechin, and gallotannin, which exhibit diverse pharmacological potentials (Maldonado-Celis et al., 2019). Numerous studies have reported its biological activities, including antioxidant (Kumar et al., 2021), anti-inflammatory (Sorrenti et al., 2023), antimicrobial (Alaiya & Odeniyi, 2023), antimicrobial (Mirza et al., 2020), antidiabetic (Usai et al., 2022), hepatoprotective (Zhao et al., 2021), and immunomodulatory (Lebaka et al., 2021) effects. These properties position *Mangifera indica* L. as a promising candidate for the development of scientifically evidence-based herbal medicines and health supplements (Lauricella et al., 2017).

Over the past two decades, research on *Mangifera indica* L. has grown rapidly, driven by a global trend toward the utilization of natural resources as alternatives or complements to conventional therapies (Iman et al., 2025). wever, publications on this topic are scattered across various journals, countries, and disciplines, making it challenging for researchers and industry stakeholders to gain a comprehensive understanding of current trends, leading contributors, and research foci. This is where bibliometric analysis plays a critical role as a tool for quantitatively and visually mapping the development of scientific knowledge.

Bibliometric analysis is a method that utilizes scientific publication data to identify research patterns, author collaborations, leading journals, prominent institutions, contributing countries, and the most frequently studied topics (Abuhassna et al., 2023). By using internationally recognized databases such as Scopus, research can encompass a broad range of well-indexed literature with high-quality standards (Baas et al., 2020).

Various software tools, such as Biblioshiny (based on the Bibliometrix package in R) and VOSviewer, enable researchers to transform this data into visual maps that facilitate interpretation (Husaeni & Nandiyanto, 2021; Moral-Munoz et al., 2020). Biblioshiny excels in presenting descriptive analyses (number of articles, citations, top journals, leading authors, affiliations, and contributing countries) (Ullah et al., 2023), whereas VOSviewer is effective for visualizing keyword co-occurrence relationships, which can reveal research foci and potential directions for future studies (Malahim et al., 2023).

Although the pharmacological potential and biological activities of *Mangifera indica* L. have been reported in various publications, to date, no comprehensive Scopus-based bibliometric study has systematically mapped research trends, leading contributors, and topic interconnections in this field. Therefore, this study is necessary to fill that gap. The findings are expected to serve as a strategic reference for researchers, academics, the pharmaceutical industry, and policymakers in determining research priorities and strategies for developing *Mangifera indica* L.-based products.

Objective

The objective of this study is to conduct a bibliometric analysis of scientific publications related to the pharmacological potential and biological activities of *Mangifera indica* L. using the Scopus database. Specifically, the study aims to analyze publication and citation trends in this field, identify the main contributing journals, authors, affiliations, and countries, and visualize keyword co-occurrence maps of related publications using VOSviewer.

Method

This study adopted a bibliometric approach to systematically evaluate global research trends on the pharmacological potential and bioactivity of *Mangifera indica* L. Bibliometric analysis is a quantitative method that applies mathematical and statistical techniques to analyze and map patterns in scientific publications (Araújo et al., 2007). In recent years, the combination of bibliometric techniques with content analysis has gained increasing attention among researchers because it allows for a more comprehensive understanding of the intellectual structure, collaboration patterns, and thematic evolution within a research field (Koskinen et al., 2008). By employing citation, co-citation, co-authorship, and keyword co-occurrence analyses, bibliometric methods can reveal research dynamics, emerging trends, and knowledge dissemination pathways (Yu et al., 2017, 2019). This approach has been widely applied to identify research trends (Akhavan et al., 2016; Yu et al., 2020), analyze collaborations among authors and institutions (Perianes-Rodriguez et al., 2016), and explore thematic clustering within scientific disciplines (Akhavan et al., 2016; Merigó & Yang, 2017).

The dataset for this research was retrieved from the Scopus database, which was selected for its extensive coverage of multidisciplinary peer-reviewed literature and its suitability for bibliometric studies (Ball & Tunger, 2006; Vieira & Gomes, 2009). The search was performed on 14 August 2025 and focused on publications related to Mangifera indica L. and its pharmacological and bioactive properties. The search query was structured using Boolean operators and field codes as follows:

TITLE-ABS-KEY ("Mangifera indica" OR "Mangifera indica var. indica" OR "sweet fragrant mango" OR "sweet fragrant") AND TITLE-ABS-KEY ("leaf extract" OR "leaves extract" OR "leaf extracts" OR "mango leaf" OR "mango leaves") AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "re")) AND (LIMIT-TO (LANGUAGE , "English"))

Only English-language journal articles in the final publication stage were considered. The search period covered the years 2015 to 2024, resulting in 305 documents that met the inclusion criteria. Exclusion criteria included conference proceedings, book chapters, review papers without original bibliometric data, and non-English publications to maintain dataset consistency.

Scopus was chosen over other bibliographic databases, such as Web of Science, because of its broader coverage of journals in pharmacology, agricultural sciences, and natural products chemistry (Fahimnia et al., 2015; Mishra et al., 2018). The search strategy utilized Boolean operators and field codes (TITLE-ABS-KEY) to ensure precise retrieval of relevant literature. Only peer-reviewed journal articles were retained in the dataset to guarantee that the analysis represented validated and citable research outputs within the selected scope.

The collected data were processed and visualized using a combination of analytical tools. Microsoft Excel 2021 was employed to perform descriptive statistical analyses and evaluate publication trends, including annual growth rates. The Bibliometrix package and its web-based interface Biblioshiny in R-Studio were used to conduct advanced bibliometric mapping, such as assessing author productivity, journal impact, and thematic evolution (Ullah et al., 2023). VOSviewer version 1.6.20 was applied to generate network visualizations of co-authorship, co-citation, and keyword co-occurrence, enabling the identification of structural and thematic relationships within the dataset (Waltman & Van Eck, 2013). Additionally, Flourish was used to produce interactive and visually appealing charts to enhance the interpretability and presentation of the results.

The bibliometric assessment comprised three major analytical components. General performance analysis was conducted to determine annual publication trends and identify the most productive authors, institutions, and countries. Citation analysis was performed to highlight the most cited articles, influential journals, and high-impact authors in the field. Network and content analyses were then used to examine collaboration patterns, co-citation structures, and keyword co-occurrence networks, which allowed the identification of thematic clusters and the mapping of interdisciplinary linkages.

Result

Annual Publication Trends

The annual distribution of publications from 2015 to 2024 reveals a gradual yet notable increase in research productivity over the last decade. Between 2015 and 2022, the output remained relatively stable, ranging between 12 and 24 articles per year. A significant surge occurred in 2023, with 50 publications, followed by an even higher output in 2024, reaching 54 publications—the highest number recorded in the study period. This upward trend indicates growing scholarly interest in the pharmacological and bioactive properties of Mangifera indica L. The number of citable years, which represents the potential time span for accumulating citations, decreased progressively for more recent publications, from 11 years in 2015 to only 2 years in 2024. This pattern reflects both the recency of the latest research and the accelerated pace of scientific output in recent years, particularly within the context of pharmaceutical applications and natural product research.

Table 1. Annual distribution of publications and corresponding citable years from 2015 to 2024, showing a sharp increase in research output in recent years, with the highest numbers recorded in 2024 (54 publications) and 2023 (50 publications), while citable years decrease progressively for more recent publications.

Table 1. Annual distribution of publications and corresponding citable years from 2015 to 2024

Year	N	CitableYears
2015	18	11
2016	12	10
2017	18	9
2018	18	8
2019	20	7

The significant increase in publications over the past two years (2023 and 2024) indicates a surge of scientific interest in Mangifera indica L. This trend reflects the growing global focus on natural products, particularly tropical plants, as primary sources for novel drug discovery (Cristani & Micale, 2024). Over the last decade, research funding in the field of phytopharmaceuticals has notably increased, especially in biodiversity-rich countries across Asia and Africa (Sydnes, 2018). Additionally, the COVID-19 pandemic has intensified interest in natural products with potential immunomodulatory, antioxidant, and antiviral activities (Khadka et al., 2021). Many studies have aimed to identify plant-derived active compounds with protective effects against oxidative stress and inflammation, which are critical factors in the pathogenesis of both infectious and degenerative diseases (Bucciantini et al., 2021).

Although the number of citable years for the most recent publications is relatively low, this does not imply reduced relevance (Douaioui & Benmoussa, 2024). Newly published articles on trending topics often gain rapid citations within their early years of publication, a phenomenon known as the "early citation effect," where research that addresses timely and pressing issues attracts immediate scholarly attention (Zhang & Ma, 2023).

Journal Co-Citation Network

The journal co-citation network map (Figure 1) demonstrates the intellectual structure of the field, with Industrial Crops and Products emerging as the central and most influential node. This journal exhibits strong co-citation linkages with Molecules, Food Chemistry, and RSC Advances. Distinct thematic clusters are evident: the green cluster, dominated by Antioxidants, represents studies on bioactive compounds and oxidative stress; the blue cluster, centered around Colloids and Surfaces B: Biointerfaces, focuses on nanomaterials and biointerfaces; while the red cluster connects multidisciplinary journals covering applied agricultural, chemical, and biological sciences. The central position of Industrial Crops and Products suggests its role as a bridging platform, integrating research across food science, natural products chemistry, and bio-based industrial applications.

Figure 1. Journal co-citation network map illustrating the relationships among the most frequently cited journals.

Industrial Crops and Products serves as the central node, showing strong citation links with journals such as Molecules, Food Chemistry, and RSC Advances. Distinct color clusters represent groups of journals with closely related research themes, including green for Antioxidants and blue for Colloids and Surfaces B: Biointerfaces.

The central position of "Industrial Crops and Products" within the co-citation network highlights its importance as a primary reference source for Mangifera indica L. research. This journal's multidisciplinary scope spans agronomy, postharvest studies, natural product chemistry, and value-added processing of agricultural outputs.

Its strong connections with "Molecules" and "Food Chemistry" underscore the close integration between phytochemical research, food science, and pharmaceutical applications. "Molecules" focuses on organic and natural product chemistry, while "Food Chemistry" publishes

studies on bioactive components and their health effects. This interrelationship illustrates the cross-disciplinary nature of Mangifera indica L. research, combining chemical composition analysis with practical applications in functional foods and nutraceuticals (Yadav et al., 2024).

The color-coded clusters in the co-citation map reflect thematic differentiation: the green cluster (dominated by "Antioxidants") emphasizes biological activity and health effects; the blue cluster (linked to "Colloids and Surfaces B: Biointerfaces") points to nanotechnology applications, particularly nanoparticle-based drug delivery systems from plant extracts; and the red cluster connects multidisciplinary journals, highlighting the topic's relevance to industrial sustainability.

Most Relevant Authors

Analysis of author productivity (Figure 2) identifies CASAS L and MANTELL C as the leading contributors, each with seven publications. They are followed by DAT NM, HAI ND, HIEU NH, and TAI LT, each with five publications. Several other authors, including BASTI S, CHAMOULP, GARCIA-CASAS I, and HUONG LM, have each produced four articles. This distribution indicates that while a small number of authors dominate output in the field, there exists a substantial group of moderately productive researchers contributing to the knowledge base on Mangifera indica L. . CASAS L and MANTELL C lead with seven publications each, followed by DAT NM, HAI ND, HIEU NH, and TAI LT with five publications, and several others with four publications.

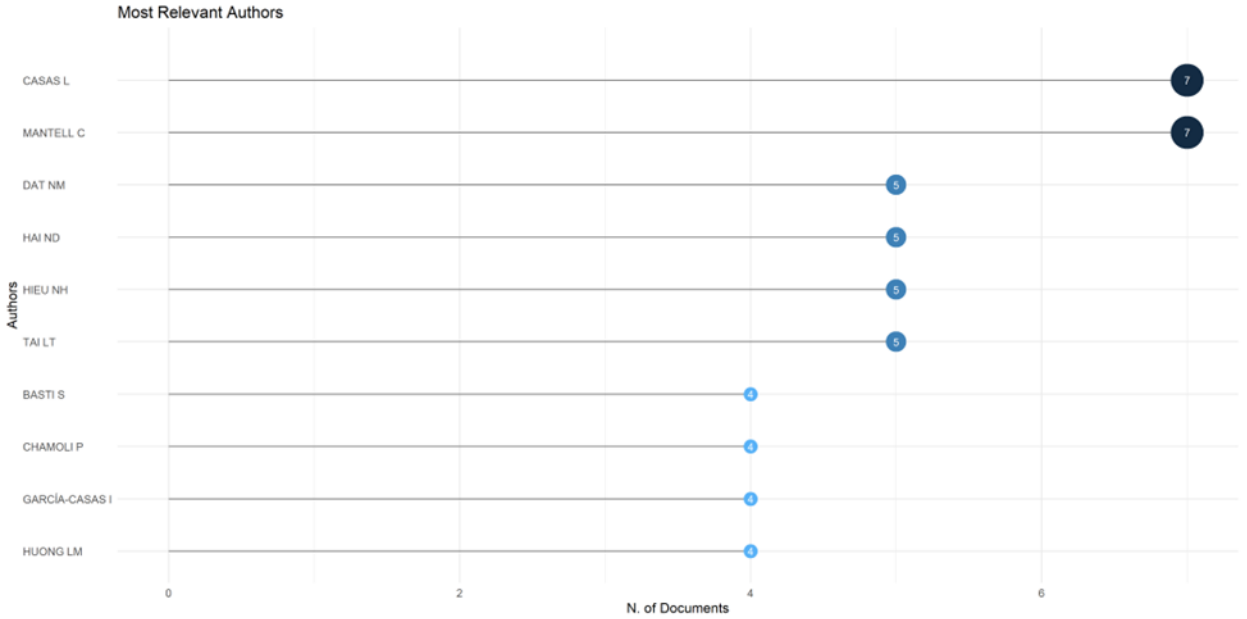

Figure 2. Most relevant authors in the dataset, ranked by the number of published documents.

The dominance of CASAS L and MANTELL C as the most prolific authors indicates the presence of core research groups that consistently produce high-quality studies. These authors typically benefit from strong international collaborations, access to advanced research facilities, and sustained funding support.

Other authors with medium productivity (4–5 publications) also contribute significantly to the field. The participation of a broad range of researchers worldwide ensures that the development of this research area is not solely dependent on a few key authors, thereby promoting long-term sustainability and enriching the diversity of perspectives in published works (Batubara et al., 2024).

Most Relevant Affiliations

Institutional analysis (Figure 3) shows that the Ho Chi Minh City University of Technology (HCMUT) is the most productive institution, contributing 47 publications. The University of Cadiz follows with 38 articles, and Tamil Nadu Agricultural University ranks third with 25 publications. Other key contributors include the Federal University of Viçosa (22 articles), the University of Las Palmas de Gran Canaria (21 articles), and Chiang Mai University (17 articles). Additional institutions, such as Mahatma Gandhi University, the University of the Philippines Los Baños, Can Tho University of Medicine and Pharmacy, and Hainan University, have also made significant contributions, with outputs ranging from 11 to 14 publications.

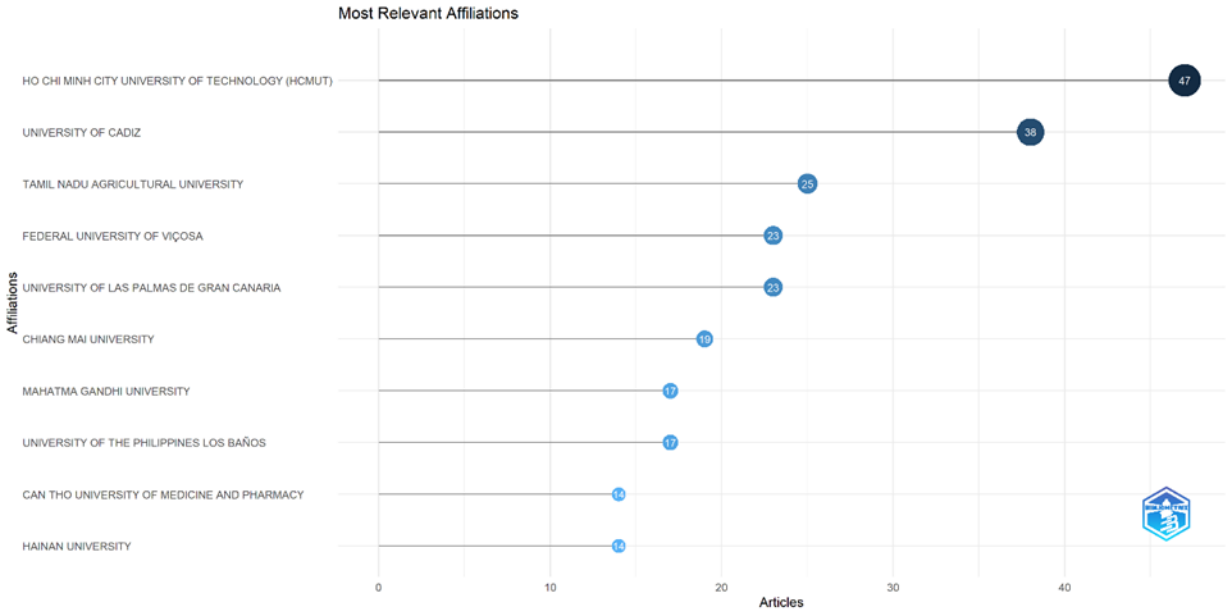

Figure 3. Most relevant affiliations in the dataset, ranked by the number of published articles.

The Ho Chi Minh City University of Technology (HCMUT) leads with 47 articles, followed by the University of Cadiz with 38. Tamil Nadu Agricultural University ranks third with 25 articles, while other institutions such as the Federal University of Viçosa, University of Las Palmas de Gran Canaria, and Chiang Mai University contribute between 19 and 23 articles.

The leading role of Ho Chi Minh City University of Technology (HCMUT) with 47 publications underscores Vietnam's emergence as a research hub in this area, likely supported by national policies promoting natural product research and strategic partnerships with international universities (Nguyen et al., 2017).

Institutions such as the University of Cadiz (Spain) and Tamil Nadu Agricultural University (India) further emphasize the global scope of Mangifera indica L. research. These institutions engage in both fundamental studies, such as phytochemical analysis, and applied research, including extraction technologies and the formulation of pharmaceutical preparations based on mango-derived bioactive compounds.

International Collaboration Patterns

The global co-authorship network (Figure 4) highlights India as the leading contributor, represented by the largest node size, signifying both high research productivity and extensive

international collaborations. Distinct collaboration clusters are apparent: one involving India, Pakistan, and Nigeria; another linking the United States, Spain, and the United Kingdom; and a third connecting China, Egypt, and South Korea. Countries such as Saudi Arabia, Malaysia, Brazil, and Indonesia also play crucial roles in linking regional research networks, underscoring the field's diverse and interconnected global research landscape.

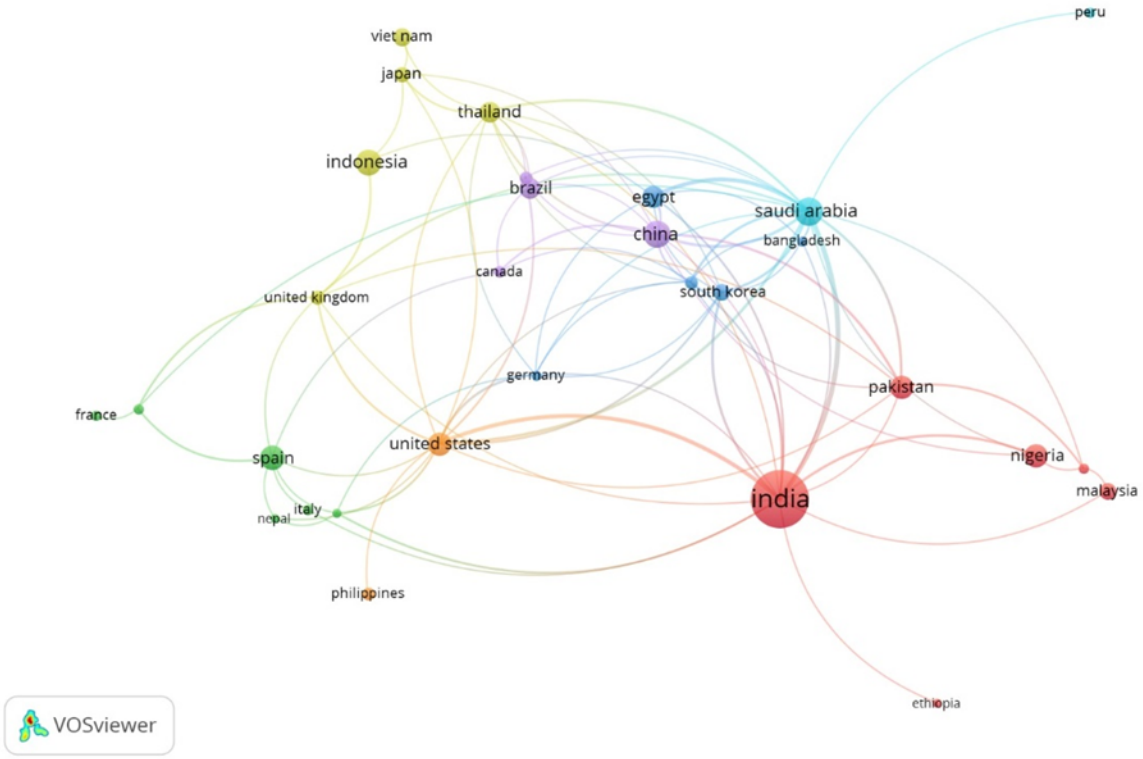

Figure 4. International collaboration network map of countries based on co-authorship patterns.

Larger nodes indicate higher research output, with India emerging as the most prominent contributor, followed by the United States, China, and Saudi Arabia. Colored clusters represent collaborative groups, illustrating strong research partnerships between countries such as India–Pakistan–Nigeria, United States–Spain–United Kingdom, and China–Egypt–South Korea.

India holds a central position in the international collaboration network, which is expected given its status as one of the largest mango producers globally and its long-standing tradition in herbal medicine through Ayurveda (Krishna et al., 2020; Mitra & Devi, 2016). Collaborations involving India–Pakistan–Nigeria tend to focus on exploring local resources and evaluating the biological activities of plant extracts (Gupta et al., 2018; Ungogo et al., 2020).

The United States–Spain–United Kingdom partnership demonstrates the contribution of technologically advanced countries to high-level research, including plant genome mapping and modern drug delivery system formulation (Cao et al., 2025). Meanwhile, collaborations between China–Egypt–South Korea reflect a trend toward integrating nanotechnology and biotechnology in developing Mangifera indica L. -derived products (Hou et al., 2025; Shahbaz et al., 2023).

Keyword Co-Occurrence Analysis

Keyword mapping (Figure 5) reveals two dominant thematic clusters in mango research. The green cluster focuses on plant-derived compounds and bioactivity, characterized by terms such as “mango,” “mangiferin,” “plant extracts,” “plant leaves,” and “antioxidant activity.” The red cluster emphasizes methodological and botanical aspects, including “green synthesis,” “scanning electron microscopy,” “leaf extracts,” and “plants (botany).” The strong interconnections between these clusters suggest interdisciplinary integration between phytochemistry, pharmacology, and nanotechnology in Mangifera indica L. research.

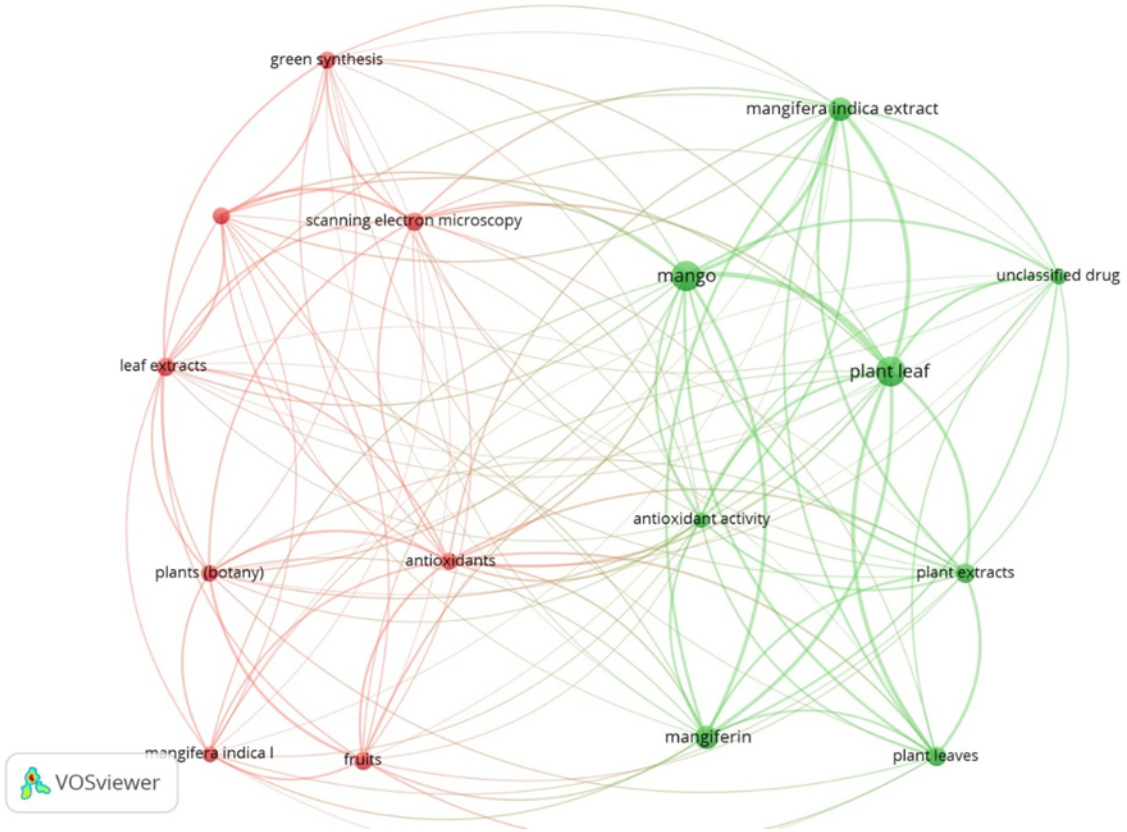

Figure 5. Keyword co-occurrence network map of research on mango (Mangifera indica)

Keyword co-occurrence network map of research on mango (Mangifera indica), showing two main clusters the green cluster focusing on plant-based compounds and bioactivity (e.g., “mango,” “mangiferin,” “plant extracts,” “antioxidant activity”) and the red cluster emphasizing methodological and botanical aspects (e.g., “green synthesis,” “scanning electron microscopy,” “leaf extracts”). The links illustrate interdisciplinary connections between phytochemistry, pharmacology, and nanotechnology research.

The green cluster, with keywords such as “mango,” “mangiferin,” and “antioxidant activity,” reflects research focusing on the identification of bioactive compounds and their health benefits. Mangiferin, for example, is a glycosylated xanthone with demonstrated anti-inflammatory, anticancer, and antidiabetic properties (Kumar et al., 2021).

The red cluster, featuring keywords such as “green synthesis” and “scanning electron microscopy,” represents the application of environmentally friendly methods to produce plant-

based nanomaterials (Chandraker et al., 2021). This approach offers two key advantages: reducing the use of hazardous chemicals and enhancing the biocompatibility of the resulting materials (Chandraker et al., 2022).

The connection between these clusters illustrates the integration of phytochemical research and material science, where bioactive compounds are explored not only for their direct pharmacological effects but also for use in modern drug delivery systems, such as nanoparticles that improve the bioavailability of active compounds (Elmowafy et al., 2023).

Most Cited Articles

Citation analysis (Table 2) indicates that the most influential publication is by Devatha CP (2016) in the Journal of Cleaner Production, with 346 total citations and an average of 34.60 citations per year. This is closely followed by Kumawat MK (2017) in ACS Sustainable Chemistry & Engineering with 335 citations (37.22 citations/year) and Ramezanzadeh M (2019) in Applied Surface Science, which, despite being more recent, has achieved 281 citations with the highest average annual citation rate of 40.14. Rajeshkumar S (2018) in Enzyme and Microbial Technology and Kumar M (2021) in Antioxidants also rank among the top five most cited works, the latter showing particularly rapid citation growth given its recent publication date.

Table 2. Most cited papers in the dataset

Paper	DOI	Total Citations	TC per Year
DEVATHA CP, 2016, J CLEAN PROD (Devatha et al., 2016)	10.1016/j.jclepro.2016.09.019	346	34.60
KUMAWAT MK, 2017, ACS SUSTAINABLE CHEM ENG (Kumawat et al., 2017)	10.1021/acssuschemeng.6b01893	335	37.22
RAMEZANZADEH M, 2019, APPL SURF SCI (Ramezanzadeh et al., 2019)	10.1016/j.apsusc.2018.09.029	281	40.14
RAJESHKUMAR S, 2018, ENZYME MICROB TECHNOL (Rajeshkumar et al., 2018)	10.1016/j.enzmictec.2018.06.009	280	35.00
KUMAR M, 2021, ANTIOXIDANTS (Kumar et al., 2021)	10.3390/antiox10020299	144	28.80

Most cited papers in the dataset, led by Devatha CP (2016) in Journal of Cleaner Production with 346 citations (34.60/year), followed by Kumawat MK (2017) in ACS Sustainable Chemistry & Engineering with 335 citations (37.22/year), and Ramezanzadeh M (2019) in Applied Surface Science with 281 citations (40.14/year).

Highly cited articles often address innovative topics of broad global relevance, such as green synthesis technology, agricultural waste processing, and the development of eco-friendly materials. The works of Devatha CP (2016) and Ramezanzadeh M (2019) exemplify how Mangifera indica L. research can extend into diverse disciplines, including environmental engineering and materials science (Devatha et al., 2016; Ramezanzadeh et al., 2019).

The high citation rates of these studies indicate that Mangifera indica L. research attracts interest not only from pharmaceutical and natural product chemists but also from academics and professionals in industrial, agricultural, and environmental sectors (Tirado-Kulieva

et al., 2021). This underscores the strategic importance of Mangifera indica L. as a versatile natural resource with wide-ranging applications (Chaksmithanont et al., 2024).

Interpret the Results

The findings indicate that Mangifera indica L. research is not only expanding in volume but also diversifying in scope, integrating pharmacognosy, food science, material science, and nanotechnology. The prominence of keywords such as “mangiferin” and “antioxidant activity” underscores the ongoing focus on health-promoting bioactive compounds, while the growth of methodological research, including green synthesis, suggests a shift toward sustainable and environmentally responsible approaches. The strong global collaboration network, led by India and supported by institutions in Vietnam, Spain, and India, reflects an internationally coordinated effort to explore mango’s potential as a source of pharmaceutical, nutraceutical, and functional food products.

Compare with Previous Studies

Previous reviews have documented the pharmacological activities of Mangifera indica L. , including antioxidant, antimicrobial, and antidiabetic effects, but lacked a systematic, data-driven overview of the research landscape. This study expands upon earlier narrative reports by providing a quantitative and visual mapping of authorship patterns, thematic clusters, and citation dynamics. Unlike prior work, this analysis highlights the rapid rise in nanotechnology applications, a theme less represented in earlier literature. Additionally, the observed dominance of India in research productivity aligns with prior bibliometric studies of tropical medicinal plants but contrasts with earlier findings where Western nations held greater influence in related pharmacological research.

Highlight the Implications

These results have important implications for both science and industry. The identification of key research clusters provides a strategic guide for prioritizing funding and collaborative efforts, especially in translational research aimed at developing clinically validated mango-derived therapeutics. The methodological trends suggest that future innovations may increasingly combine phytochemistry with nanotechnology to enhance bioavailability and therapeutic efficacy. Furthermore, the observed gaps in clinical research point to a need for bridging laboratory findings with human trials, enabling the full realization of Mangifera indica L. ’s pharmaceutical and nutraceutical potential.

Discuss the Limitations

While this bibliometric analysis provides a detailed and objective overview of Mangifera indica L. research, certain limitations should be acknowledged. First, the exclusive reliance on the Scopus database may have led to the omission of relevant publications indexed elsewhere, potentially underrepresenting research from regions with limited Scopus coverage. Second, citation counts favor older publications, although the high annual citation rates observed for recent works partially mitigate this bias. Third, the analysis focused on bibliometric indicators and did not include qualitative assessments of methodological rigor or experimental validity, which are essential for determining translational potential. Future studies should address these

limitations by incorporating multi-database searches, altmetric indicators, and systematic reviews to provide a more holistic evaluation of the field.

Suggest Future Research

Future investigations should expand the dataset by integrating multiple bibliographic databases to ensure broader coverage and reduce geographic bias. Combining bibliometric mapping with systematic or scoping reviews could provide deeper insights into research quality and identify evidence gaps. Additionally, there is a need for longitudinal analyses that track the transition of Mangifera indica L. research from laboratory-based phytochemical and bioactivity studies to preclinical and clinical trials. Emerging research areas such as metabolomics, molecular docking, nanoformulation development, and pharmacokinetic profiling warrant further exploration to optimize therapeutic applications. Greater emphasis should also be placed on sustainability-oriented studies, including the valorization of mango by-products and environmentally friendly extraction methods. Finally, fostering multidisciplinary collaborations that bridge pharmacognosy, nanotechnology, and clinical sciences will be critical to translating the rich bioactive potential of Mangifera indica L. into accessible, evidence-based pharmaceutical and nutraceutical products.

Conclusion

Based on our bibliometric analysis, research on *Mangifera indica* has experienced significant growth over the past decade, driven by increasing global interest in plant-derived bioactive compounds, sustainable natural product development, and interdisciplinary integration of pharmacognosy with material sciences. The field is characterized by strong international collaboration, with India emerging as a leading contributor, and thematic clustering around phytochemical-bioactivity investigations and advanced methodologies such as green synthesis and nanotechnology. However, geographical disparities and the limited translation of experimental findings into clinical or industrial applications remain notable gaps. Future research should prioritize strengthening cross-regional collaborations, enhancing translational studies, and integrating metabolomic, preclinical, and clinical data to fully harness the pharmaceutical and nutraceutical potential of *Mangifera indica* L.

Community Implication

The growing body of evidence on Mangifera indica L. can benefit communities by promoting the development of affordable, plant-based therapies and functional foods that support public health, particularly in low and middle income countries where access to conventional pharmaceuticals may be limited. Sustainable utilization of mango by-products for bioactive compound extraction can also reduce agricultural waste and provide new income streams for rural farmers. These outcomes support broader goals of environmental sustainability, local economic empowerment, and improved health equity.

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References

1. Akhavan, P., Ebrahim, N. A., Fetrati, M. A., & Pezeshkan, A. (2016). Major trends in knowledge management research: A bibliometric study. Scientometrics, 107, 1249–1264.
2. Araújo, A., Carvalho, A. C. P. de L. F. de, & Braga, A. (2007). Journal of Intelligent and Fuzzy Systems.
3. Ball, R., & Tunger, D. (2006). Bibliometric analysis-a new business area for information professionals in libraries? Support for scientific research by perception and trend analysis. Scientometrics, 66, 561–577.
4. Batubara, H. S., Jalinus, N., & Rizal, F. (2024). Mapping the Frontier: A Bibliometric Analysis of AI in Tertiary Education. IJLTER. ORG, 23(10), 62–81.
5. Bucciantini, M., Leri, M., Nardiello, P., Casamenti, F., & Stefani, M. (2021). Olive polyphenols: Antioxidant and anti-inflammatory properties. Antioxidants, 10(7), 1044.
6. Cao, S., Pang, Y., Wei, Y., Wang, D., Xiong, A., Yang, J., & Zeng, H. (2025). Unveiling the dynamic trends of plant-derived exosome nanovesicles-based theranostics: Through bibliometric and visualized analysis. Frontiers in Medicine, 12, 1553915.
7. Chaksmithanont, P., Bangsitthideth, K., Arunprasert, K., Patrojanasophon, P., & Pornpitchanarong, C. (2024). Statistical-Based Optimization of Modified Mangifera indica Fruit Starch as Substituent for Pharmaceutical Tableting Excipient. Polymers, 16(18), 2653.
8. Chandraker, S. K., Ghosh, M. K., Lal, M., & Shukla, R. (2021). A review on plant-mediated synthesis of silver nanoparticles, their characterization and applications. Nano Express, 2(2), 022008.
9. Chandraker, S. K., Lal, M., Dhruve, P., Yadav, A. K., Singh, R. P., Varma, R. S., & Shukla, R. (2022). Bioengineered and biocompatible silver nanoparticles from Thalictrum foliolosum DC and their biomedical applications. Clean Technologies and Environmental Policy, 24(8), 2479–2494.
10. Cristani, M., & Micale, N. (2024). Bioactive compounds from medicinal plants as potential adjuvants in the treatment of mild acne vulgaris. Molecules, 29(10), 2394.
11. Devatha, C., Thalla, A. K., & Katte, S. Y. (2016). Green synthesis of iron nanoparticles using different leaf extracts for treatment of domestic waste water. Journal of Cleaner Production, 139, 1425–1435.
12. Douaioui, K., & Benmoussa, O. (2024). Insights into industrial efficiency: An empirical study of blockchain technology. Big Data and Cognitive Computing, 8(6), 62.
13. Elmowafy, M., Shalaby, K., Elkomy, M. H., Alsaidan, O. A., Gomaa, H. A., Abdelgawad, M. A., & Mostafa, E. M. (2023). Polymeric nanoparticles for delivery of natural bioactive agents: Recent advances and challenges. Polymers, 15(5), 1123.
14. Fahimnia, B., Sarkis, J., & Davarzani, H. (2015). Green supply chain management: A review and bibliometric analysis. International Journal of Production Economics, 162, 101–114.
15. Gupta, B., Ahmed, K. M., Dhawan, S., & Gupta, R. (2018). Yoga research a scientometric assessment of global publications output during 2007-16. Pharmacognosy Journal, 10(3).
16. Hou, X., Jiang, X., Zhang, W., & Liu, J. (2025). Bibliometric analysis of nanomaterials in hepatocellular carcinoma treatment: Research trends, knowledge structures, and emerging insights (2000–2024). Discover Oncology, 16(1), 1–23.
17. Khadka, D., Dhamala, M. K., Li, F., Aryal, P. C., Magar, P. R., Bhatta, S., Thakur, M. S., Basnet, A., Cui, D., & Shi, S. (2021). The use of medicinal plants to prevent COVID-19 in Nepal. Journal

of Ethnobiology and Ethnomedicine, 17(1), 26.
18. Koskinen, J., Isohanni, M., Paajala, H., Jääskeläinen, E., Nieminen, P., Koponen, H., Tienari, P., & Miettunen, J. (2008). How to use bibliometric methods in evaluation of scientific research? An example from Finnish schizophrenia research. Nordic Journal of Psychiatry, 62(2), 136–143.
19. Krishna, S., Dinesh, K., & Nazeema, P. (2020). Globalizing ayurveda-opportunities and challenges. Int J Health Sci Res, 10(3), 55–68.
20. Kumar, M., Saurabh, V., Tomar, M., Hasan, M., Changan, S., Sasi, M., Maheshwari, C., Prajapati, U., Singh, S., & Prajapat, R. K. (2021). Mango (Mangifera indica L.) Leaves: Nutritional Composition, Phytochemical Profile, and Health-Promoting Bioactivities. Antioxidants (Basel, Switzerland), 10(2), 299.
21. Merigó, J. M., & Yang, J.-B. (2017). A bibliometric analysis of operations research and management science. Omega, 73, 37–48.
22. Mishra, D., Gunasekaran, A., Papadopoulos, T., & Childe, S. J. (2018). Big Data and supply chain management: A review and bibliometric analysis. Annals of Operations Research, 270, 313–336.
23. Mitra, S., & Devi, H. (2016). Organic horticulture in India. Horticulturae, 2(4), 17.
24. Nguyen, T. V., Ho-Le, T. P., & Le, U. V. (2017). International collaboration in scientific research in Vietnam: An analysis of patterns and impact. Scientometrics, 110(2), 1035–1051.
25. Perianes-Rodriguez, A., Waltman, L., & Van Eck, N. J. (2016). Constructing bibliometric networks: A comparison between full and fractional counting. Journal of Informetrics, 10(4), 1178–1195.
26. Ramezanzadeh, M., Bahlakeh, G., Sanaei, Z., & Ramezanzadeh, B. (2019). Corrosion inhibition of mild steel in 1 M HCl solution by ethanolic extract of eco-friendly Mangifera indica (mango) leaves: Electrochemical, molecular dynamics, Monte Carlo and ab initio study. Applied Surface Science, 463, 1058–1077.
27. Shahbaz, M., Akram, A., Raja, N. I., Mukhtar, T., Mehak, A., Fatima, N., Ajmal, M., Ali, K., Mustafa, N., & Abasi, F. (2023). Antifungal activity of green synthesized selenium nanoparticles and their effect on physiological, biochemical, and antioxidant defense system of mango under mango malformation disease. PLoS One, 18(2), e0274679.
28. Sydnes, L. K. (2018). Health for All in Dhaka: CHEMRAWN helps establish an International Centre for Natural Product Research. Chemistry International, 40(2), 17–19.
29. Tirado-Kulieva, V., Atoche-Dioses, S., & Hernández-Martínez, E. (2021). Phenolic compounds of mango (Mangifera indica) by-products: Antioxidant and antimicrobial potential, use in disease prevention and food industry, methods of extraction and microencapsulation. Scientia Agropecuaria, 12(2), 283–293.
30. Ullah, R., Asghar, I., & Griffiths, M. G. (2023). An Integrated Methodology for Bibliometric Analysis: A Case Study of Internet of Things in Healthcare Applications. Sensors, 23(1). https://doi.org/10.3390/s23010067
31. Ungogo, M. A., Ebiloma, G. U., Ichoron, N., Igoli, J. O., De Koning, H. P., & Balogun, E. O. (2020). A review of the antimalarial, antitrypanosomal, and antileishmanial activities of natural compounds isolated from Nigerian flora. Frontiers in Chemistry, 8, 617448.
32. Vieira, E. S., & Gomes, J. A. (2009). A comparison of Scopus and Web of Science for a typical university. Scientometrics, 81, 587–600.
33. Waltman, L., & Van Eck, N. J. (2013). A smart local moving algorithm for large-scale

modularity-based community detection. The European Physical Journal B, 86(11), 471.
34. Yadav, S., Malik, K., Moore, J. M., Kamboj, B. R., Malik, S., Malik, V. K., Arya, S., Singh, K., Mahanta, S., & Bishnoi, D. K. (2024). Valorisation of agri-food waste for bioactive compounds: Recent trends and future sustainable challenges. Molecules, 29(9), 2055.
35. Yu, D., Xu, Z., & Fujita, H. (2019). Bibliometric analysis on the evolution of applied intelligence. Applied Intelligence, 49(2), 449–462.
36. Yu, D., Xu, Z., & Pedrycz, W. (2020). Bibliometric analysis of rough sets research. Applied Soft Computing, 94, 106467.
37. Yu, D., Xu, Z., Pedrycz, W., & Wang, W. (2017). Information sciences 1968–2016: A retrospective analysis with text mining and bibliometric. Information Sciences, 418, 619–634.
38. Zhang, L., & Ma, L. (2023). Is open science a double-edged sword?: Data sharing and the changing citation pattern of Chinese economics articles. Scientometrics, 128(5), 2803–2818.
39. Firmansyah, A., Setiawan, H., & Ariyanto, H. (2021). Studi Kasus Implementasi Evidence-Based Nursing: Water Tepid Sponge Bath Untuk Menurunkan Demam Pasien Tifoid. *Viva Medika: Jurnal Kesehatan, Kebidanan Dan Keperawatan*, *14*(2), 174–181.
40. Setiawan, H., Ariyanto, H., Firdaus, F. A., & Khaerunnisa, R. N. (2021). pendidikan kesehatan pencegahan skabies di pondok pesantren al-arifin. *Martabe*, *4*(1), 110–117.
41. Theofanidis, D. (2007). Chronic illness in childhood: psychosocial adaptation and nursing support for the child and family. *Health Science Jornal*, *1*(2), 1–9. Retrieved from http://www.hsj.gr/index.files/VOLUME1_2.htm