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ORIGINAL ARTICLE

Bibliometric Analysis of Propolis Research Based on ITGInsight

Yifan Wang[1,2,3] · Xi Liu[3] · Yanqing Yang[4] · Jianfang Yang[5] · Hongchi Ding[1,2,3] · Canwei Li[6] · Zizhong Yang[1,2,3] · Hairong Zhao[1,2,3] · Yu Zhao[1,2,3] · Chenggui Zhang[1,2,3] · Weihong Liu[7] · Pengfei Gao[1,2,3]

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Abstract
Propolis has attracted considerable attention for its diverse pharmacological properties. A bibliometric analysis of 4,215 propolis research papers published between 2014 and 2024 was conducted in this study. The Web of Science Core Collection database served as the data source, and ITGInsight software was utilized for analytical processing. The study delineated propolis research through multi-dimensional assessments, including national contributions, institutional affiliations, author influence, journal prominence, and thematic evolution. It revealed that Brazil, China and Turkey were the leading contributors, while the most productive institutions were the University of São Paulo (Brazil), the State University of Maringá (Brazil), and King Saud University (Saudi Arabia). Jairo Kenupp Bastos and Vassya Bankova were identified as prominent scholars, while the journals Molecules and the Journal of Apicultural Research stood out as the predominant publication platforms. Keywords analysis indicated sustained research interest were in its chemical composition and bioactivities (antioxidant, antimicrobial activities). Generally, this study summarized the landscape and trends of propolis research and offered valuable guidance for future explorations.

Keywords Propolis · Bibliometrics · Bioactivity · ITGInsight

Introduction

Propolis is a kind of natural substance produced by honeybees from plant resins, salivary secretions and wax (Li et al. 2021; Tanuğur Samanci et al. 2024a). The therapeutic application of this resinous substance can be traced back to antiquity, and the earliest documented reference was found in Aristotle's Historia Animalium (384–322 BCE), in which he described its origin and medicinal use as a pungent "black wax" for treating skin ailments, cuts and infected wounds (Aristotle 1910). It contains a heterogeneous composition of bioactive phytochemicals, including flavonoids, phenolic acids and terpenoids (Tanuğur Samanci et al. 2024b), which endow propolis with multifaceted pharmacological properties, such as antioxidant, anti-inflammatory, antimicrobial and antiviral activities (Wallis and Galarneau 2020; Bouzahouane et al. 2021).

The research continued to affirm propolis' therapeutic and other potential. For example, Phonrachom et al. (2023) developed quaternized chitosan/pectin hydrogel films and loaded with it to improve wound closure. Xu et al. (2022) observed flavonoids in it possessed the potential to treat diseases relating to oxidative stress, while Vivek P. Chavda

Yifan Wang, Xi Liu and Yanqing Yang contributed equally to this work.

✉ Weihong Liu
liuwhong@dali.edu.cn

✉ Pengfei Gao
gaodaluan@dali.edu.cn

1 Yunnan Provincial Key Laboratory of Entomological Biopharmaceutical R&D, Dali University, Dali 671000, Yunnan, China

2 National - Local Joint Engineering Research Center of Entomoceutics, Dali, Yunnan, China

3 College of Pharmacy, Dali University, Dali, Yunnan, China

4 The Second Affiliated Hospital of Kunming Medical University, Kunming, Yunnan, China

5 College of Foreign Languages, Dali University, Dali, Yunnan, China

6 College of Public Health, Dali University, Dali, Yunnan, China

7 The Library of Dali University, Dali 671000, Yunnan, China

et al. (2024) revealed that it could reduce the risk of atherosclerosis. Wang et al. (2023) identified that caffeic acid phenethyl ester isolated from it could modulate inflammatory cascades, and Martinotti et al. (2025) reviewed its anticancer properties. In addition, Pu et al. (2023) pioneered its application as bioactive food coatings. It was noteworthy that de Almeida Campos et al. (2025) found that the antibacterial activity of propolis was related to its complex and diverse phytochemical components.

Bibliometrics encompasses theoretical frameworks, analytical techniques and practical applications (Lyu et al. 2023), enabling systematic evaluation of publication trends, citation networks and research impact (Donthu et al. 2021). Its utility is well-established in medical research. For instance, Stefanis et al. (2023) conducted a bibliometric analysis of honey from 2001 to 2022 to examine its antioxidant and antimicrobial properties.

Regarding analytical software selection, contemporary bibliometric analysis requires a specialized tool to perform sophisticated data mining and visualization tasks, such as VOSviewer (for scientific knowledge mapping), CiteSpace (for literature evolution analysis), Bibliometrix (an R-based bibliometric package) and ITGInsight (an intelligent literature visualization platform). Developed by Engineer Liu Yuqin of Beijing Zhengyi Technology Co., ITGInsight enables comprehensive text mining and visual representation and offers robust capabilities for bibliometric analysis (Wang et al. 2022). Its powerful data processing and dynamic visualization capabilities were implemented in diverse research contexts, ranging from photovoltaic patent analysis (Qiao et al. 2025) to medical research mapping (Wang et al. 2021). Following a thorough comparison of existing bibliometric tools in terms of functionality and practical suitability, ITGInsight (Intelligence Insight) was adopted as the central analytical platform in the research.

Although extensive literature was accumulated in propolis research, a systematic analysis remained missing. To address it, this study introduced bibliometric analysis to analyze propolis publications from 2014 to 2024. As the first systematic quantitative research of propolis, the work filled a critical methodological gap and offered fresh insights for follow-up studies.

Materials and Methods

Data Sources and Search Strategy

The Web of Science (WoS) database, as the primary data source due to its inclusion of high-impact journals worldwide, allows users to retrieve both current and historical literature (Sevinc 2004; Mongeon and Paul-Hus 2016). Its broad coverage and detailed metadata, including titles, abstracts and keywords, is recognized as a solid foundation for bibliometric research and data visualization. The WoS Core Collection is an authoritative database operated by Clarivate Analytics, covering core academic literature across multiple disciplines and featuring citation indexing functionality.

The search was conducted in the WoS Core Collection on December 9, 2024, encompassing publications from January 1, 2014, to December 1, 2024. We employed the query TS (propolis OR “bee gelatine” OR “bee glue”), where TS denoted title, abstract and keyword fields. Then, the literature that can be used for bibliometric analysis were selected through manual screening from WoS Core Collection. Study documents were included according to the specific criteria that required clear focus on propolis or its components such as bee gelatine and bee glue. Exclusion criteria eliminated documents unrelated, which included duplicated content, incomplete data, or non-research publications, such as brief communications and opinion pieces. This approach ensured that only relevant, high-quality research was incorporated into the analysis. All identified records were exported from documents database and imported into ITGInsight for bibliometric analysis. Initial screening filtered documents by type (articles and reviews) and language (English). Finally, the refined dataset was analyzed through ITGInsight software.

Data Processing Parameter Settings

Annual publication output was recorded through ITGInsight 2.5.0, with key parameters setting as follows: term length (2–4 words), standard stopword lists, and the filter-wos1-author-use-fullname-doi-as-id preset. The study applied Top N (N = 30) ranking criteria to the 2014–2024.

Results

General Data

As illustrated in Fig. 1, the flow diagram presented the numerical distribution of publications at each sequential stage. Initially, the query yielded 5,724 records, which underwent a rigorous screening process. Specifically, during the data screening process, an initial selection was made based on document type and language. Only English articles and review publications were retained to ensure that the analysis focused on research outputs with substantial academic merit. Subsequently, manual screening was conducted to eliminate irrelevant publications. Finally, 4,215 publications were obtained for analytical procedures.

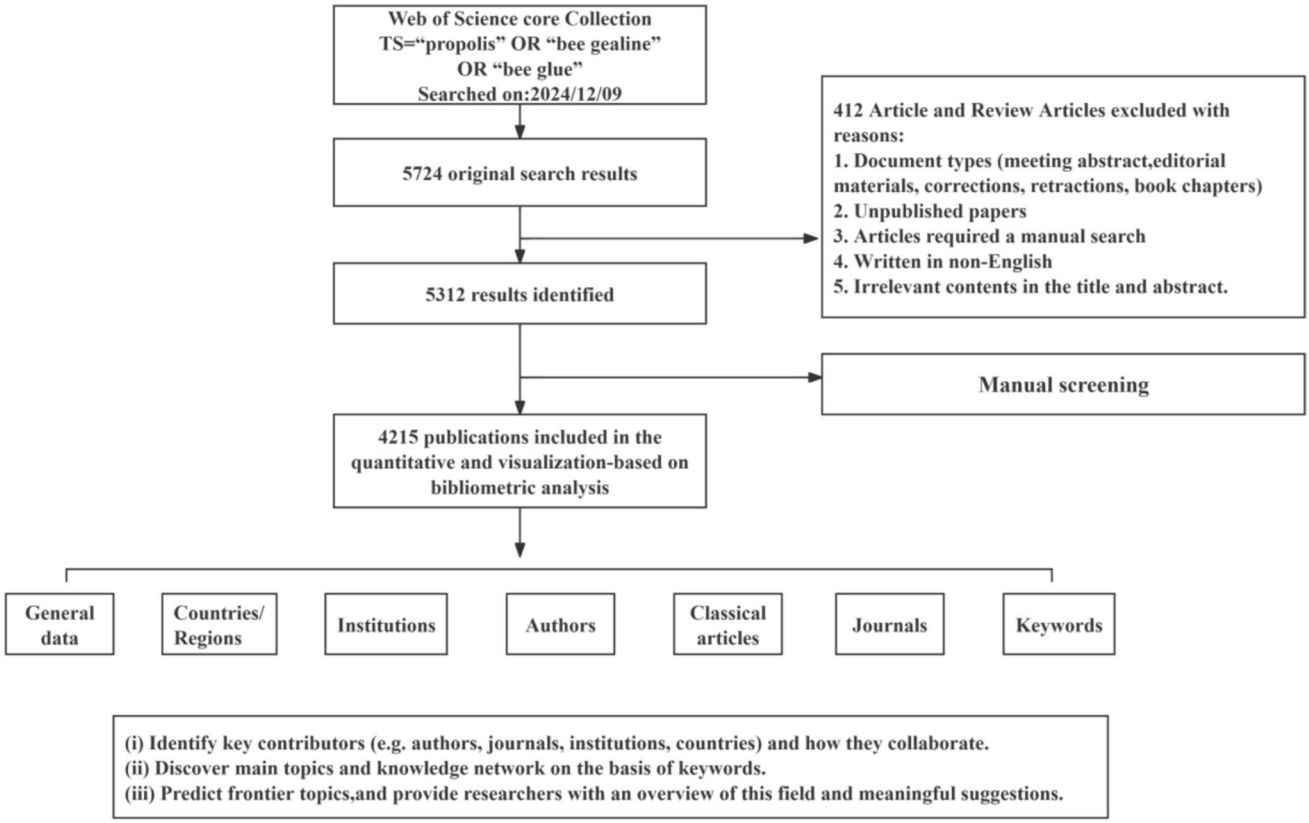


Fig. 1 Flowchart of data screening and bibliometric analysis for global propolis research (2014–2024, web of science core collection)

Publication Analysis

Publication Distribution

The distribution of publications is considered is considered a key indicator of research development trends (Zupic and Cater 2013). A total of 4,215 propolis-related publications were identified through systematic retrieval from the WoS Core Collection in the study. The resultant dataset comprised distinct publication categories: 3,820 research articles, 395 review papers, 3 book chapters, 2 editorial materials, 58 early access documents, 1 data paper and 20 conference papers, which represented the full spectrum of scholarly discourse on propolis research.

Journal Analysis of Publication Sources

As presented in Table 1 and Fig. 2, the top five journals ranked by publication volume included Molecules (161 articles, 4,245 citations), Journal of Apicultural Research (90 articles, 1,163 citations), Evidence-Based Complementary and Alternative Medicine (69 articles, 2,037 citations), Scientific Reports (56 articles, 1,646 citations), and PloS One (52 articles, 1,689 citations). Molecules emerged as the most prominent journal.

Table 1 Top 5 Journals in global propolis research (2014–2024): number of publications and total citations

Source	Documents	Citations
Molecules	161	4245
Journal of Apicultural Research	90	1163
Evidence-Based Complementary and Alternative Medicine	69	2037
Scientific Reports	56	1646
Plos One	52	1689

Analysis of Annual Publication Output

The study of propolis between 2014 and 2024 revealed a marked escalation in scholar activity through the publication numbers. As represented in Fig. 3, a total of 4,215 publications were published with an average of 383 articles in each year, equivalent to more than 31 core publications per month.

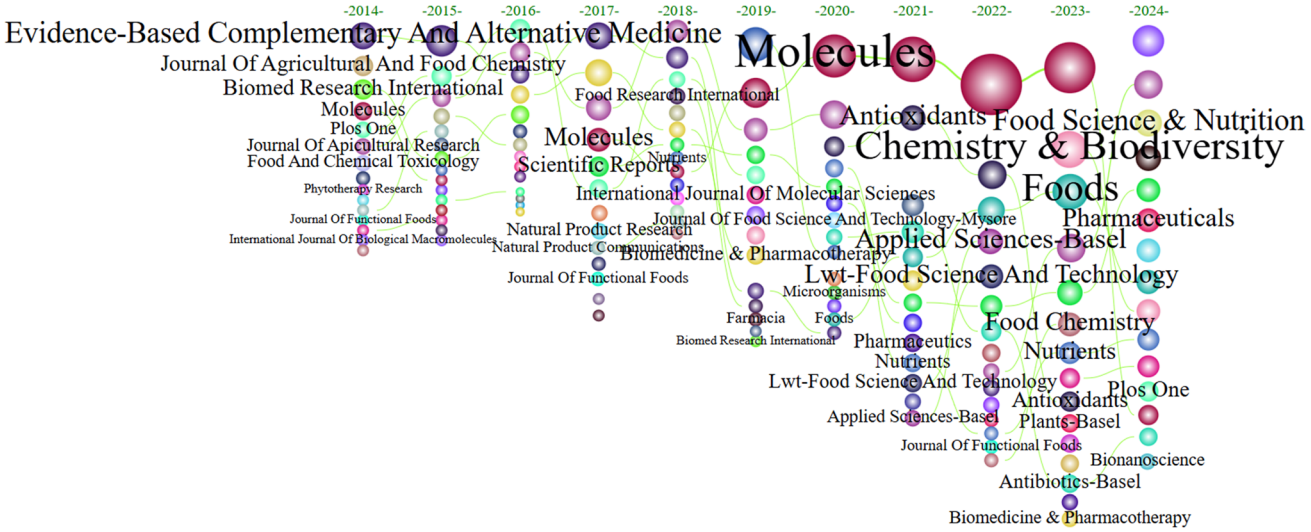


Fig. 2 Temporal distribution of propolis-related papers published in different journals (2014–2024). Different colors represent different journals, and the size of the nodes indicates the number of publications

The sustained upward trend of output from 2014 to 2024 signified intensifying research engagement with propolis. Two distinct peaks were observed in 2019 (409 publications) and 2021 (521 publications), suggesting the emergence of activity in propolis research field. Furthermore, distinct evolutionary phases were observed across the studied decade: the initial phase (2014–2018) witnessed gradual expansion from 234 to 289 annual publications, reflecting fragmented

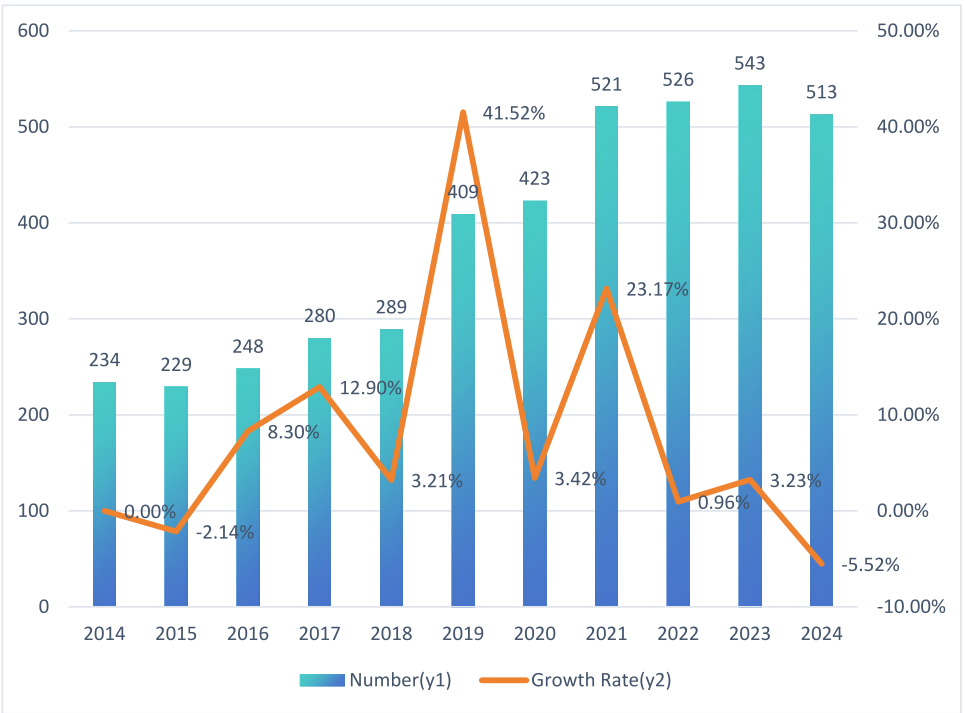


Fig. 3 Annual research output trend of global propolis research (2014–2024)

breakthrough studies or the influence of major research initiatives. After 2019, publication numbers stabilized at consistently high levels, which demonstrated sustained research research directions during this exploratory period. In contrast, the subsequent phase (2019–2024) showed significant acceleration and reached a peak of 543 publications in 2023.

Cooperation Networks between Institutions and Authors

A significant concentration was observed in the global distribution of institutions in propolis research. The top 10 institutions of research output between 2014 and 2024 were presented in Table 2. The University of São Paulo (Brazil) ranked first with 227 publications and 4,192 citations. Followed by the State University of Maringá (Brazil, 67 publications and 1132 citations), King Saud University (Saudi Arabia, 64 publications and 1441 citations), and Islamic Azad University (Iran, 59 publications and 798 citations). The University of São Paulo publication counts substantially exceeded that of the the above three institutions, demonstrating its central role in global propolis research. The Bulgarian Academy of Sciences (53 publications and 1202 citations) ranked fifth, identified as the European representative.

The institutional collaboration network (Fig. 4a) visually revealed patterns of cooperation among global propolis research institutions. The University of São Paulo occupied the center of the network, represented by the largest node size, which represented that it formed the strongest connections with other institutions, particularly with Brazil institutions. Meanwhile, it indicated that significant collaborative clusters within Brazil were established, specifically with the State University of Campinas (25 collaborative publications) and São Paulo State University (16 collaborative publications). However, direct collaborative links between Brazilian cluster and other major regional hubs, such as King Saud University, the Bulgarian Academy of Sciences, and Islamic Azad University, were found to be sparse or absent, pointing to insufficient international institutional cooperation. Co-authored papers from the University of São Paulo received an average of 28.5 citations, substantially higher than the 12.7 citations for independent studies. In addition, some regional collaboration existed in the Middle East/North Africa region, exemplified by Cairo University and the National Research Centre (9 collaborations).

Notably, although China ranked second globally in total publications (387), no Chinese institution was listed among the world's top ten most productive institutions (Table 2). By contrast, Brazil's top three institutions produced 354 publications collectively, accounting for 43.1% of its national total (822 publications). It is commanded that institutions can engage in joint research on common themes such as the analysis of propolis active components and the validation of its functional applications to promote international collaboration in propolis research.

Author productivity analysis (Table 3) revealed Jairo Kenupp Bastos from the University of São Paulo, Brazil, was the most prolific author with 55 publications (542 citations). Followed by Vassya Bankova of the Bulgarian Academy of Sciences (45 publications, 1396 citations), while Milena Popova (Canterbury Christ Church University, UK; 39 publications, 1270 citations) and Boryana Trusheva (Bulgarian Academy of Sciences; 30 publications, 912 citations) secured the third and fourth positions respectively. José Mauricio Sforcin from São Paulo State University (28 publications, 604 citations) and Badiaa Lyoussi from Sidi Mohamed Ben Abdellah University (28 publications, 661 citations) ranked fifth and sixth. Especially, although Chinese scholar Kai Wang (Chinese Academy of Agricultural Sciences) ranked seventh with 27 publications, his papers' citations reached highly to 1495, which meant that Kai Wang ranked first in co-citations (average citation rate of 55.37 per article) from the citation perspective. His research focused on the quality and function assessment of bee products along with bee biology. In addition, his high citations reflected the vibrant scholarly culture of traditional Chinese medicine (TCM) in China.

The author collaboration network (Fig. 4b) exhibited three distinct regional clusters. Bastos formed the Brazilian core, maintaining strong ties with University of São Paulo colleagues like Victor Pena Ribeiro (18 co-authored publications). Bankova and Popova constituted the dominant Bulgarian cluster (39 co-authored works). Kai Wang represented the Chinese cluster, primarily collaborating with domestic scholars such as Hu Fuliang (12 co-authored publications). However, limited international cooperation was observed among these clusters. Cross-national collaborations accounted for less than 7% of total publications (*e.g.*, 6.8% for Chinese scholars).

Table 2 Top 10 most productive institutions in global propolis research (2014–2024): country, number of publications, and total citations

No	Organization	Country	Documents	Citations
1	University of São Paulo	Brazil	227	4192
2	State University of Maringá	Brazil	67	1132
3	King Saud University	Saudi Arabia	64	1441
4	Islamic Azad University	Iran	59	798
5	Bulgarian Academy of Sciences	Bulgaria	53	1202
6	State University of Campinas	Brazil	52	1608
7	Karadeniz Tech University	Turkey	49	755
8	Cairo University	Egypt	48	865
9	São Paulo State University	Brazil	45	532
10	National Research Center	Egypt	44	723

National Analysis

The country distribution map (Fig. 5) presented the aforementioned geographical distribution characteristics, where a larger red dot indicates a greater number of publications in propolis research, and the numbers in parentheses represented the number of publications of each country from 2014 to 2024. Variations in color intensity clearly emphasized the high research density in Brazil, China, and Turkey as core hotspots, alongside notable contributions compared with nations like Iran and Egypt.

Global propolis research demonstrated significant geographic concentration. Brazil positioned No.1 with 822 publications (19.5% of total) and 15,191 citations (Table 1 in Supplementary Materials). China (387 publications, 9.18%, 8,748 citations) and Turkey (355 publications, 8.42%, 5,712 citations) followed as the second and third contributors respectively. Iran (293 publications, 6.95%, 4,861 citations) and Egypt (281 publications, 6.67%, 5,022 citations) ranked fourth and fifth.

Top Cited Articles

The core literature network in propolis research was identified through co-citation analysis. The top 10 most co-cited articles were presented in Table 4, including seven review articles and three research publications.

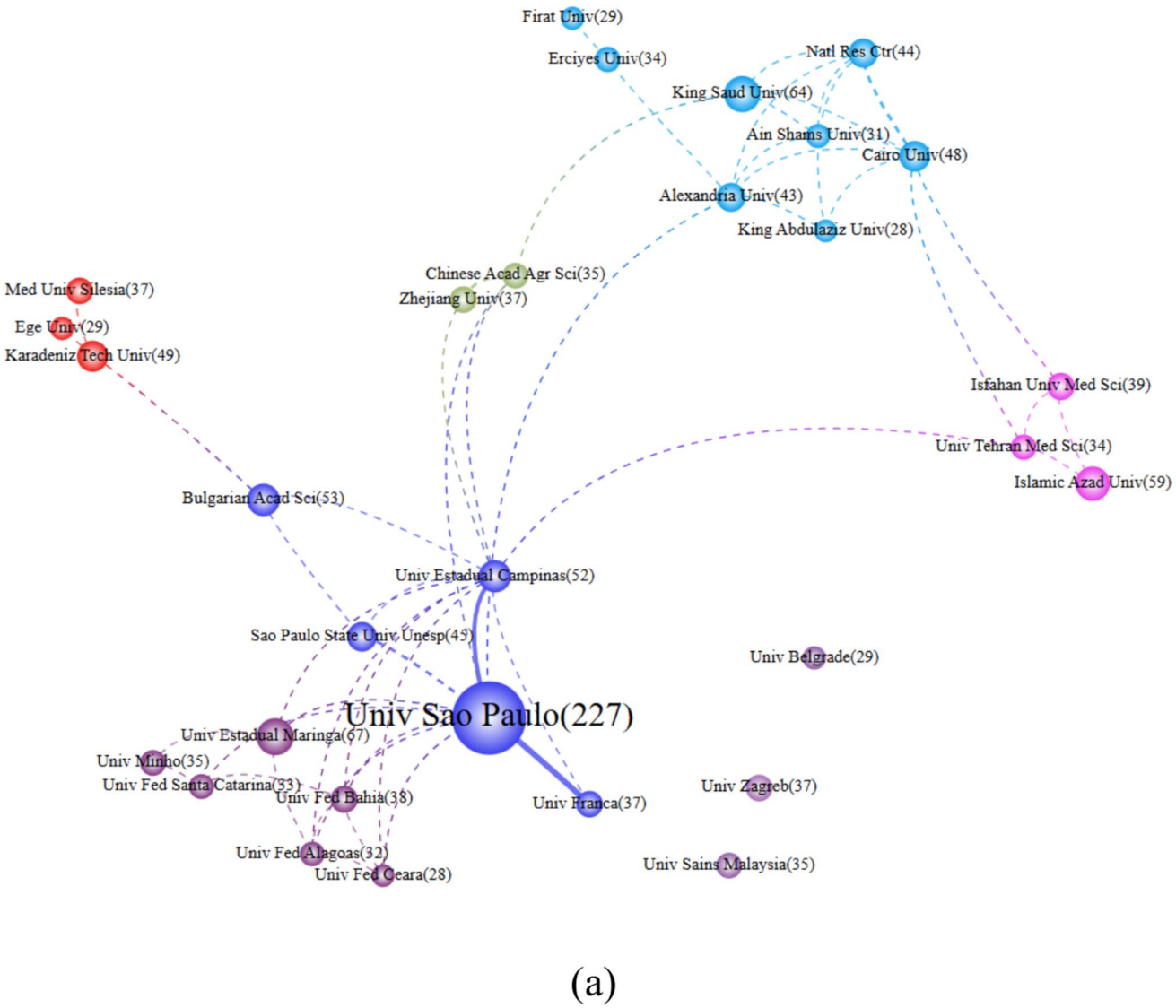


Fig. 4 (**a**) The co-institutions map of organizations. (**b**) Co-author collaboration network of global propolis research (2014–2024). Different colors indicate different clusters, and the size of nodes indicates the number of publications. The thickness of the lines represents the link strength of the countries

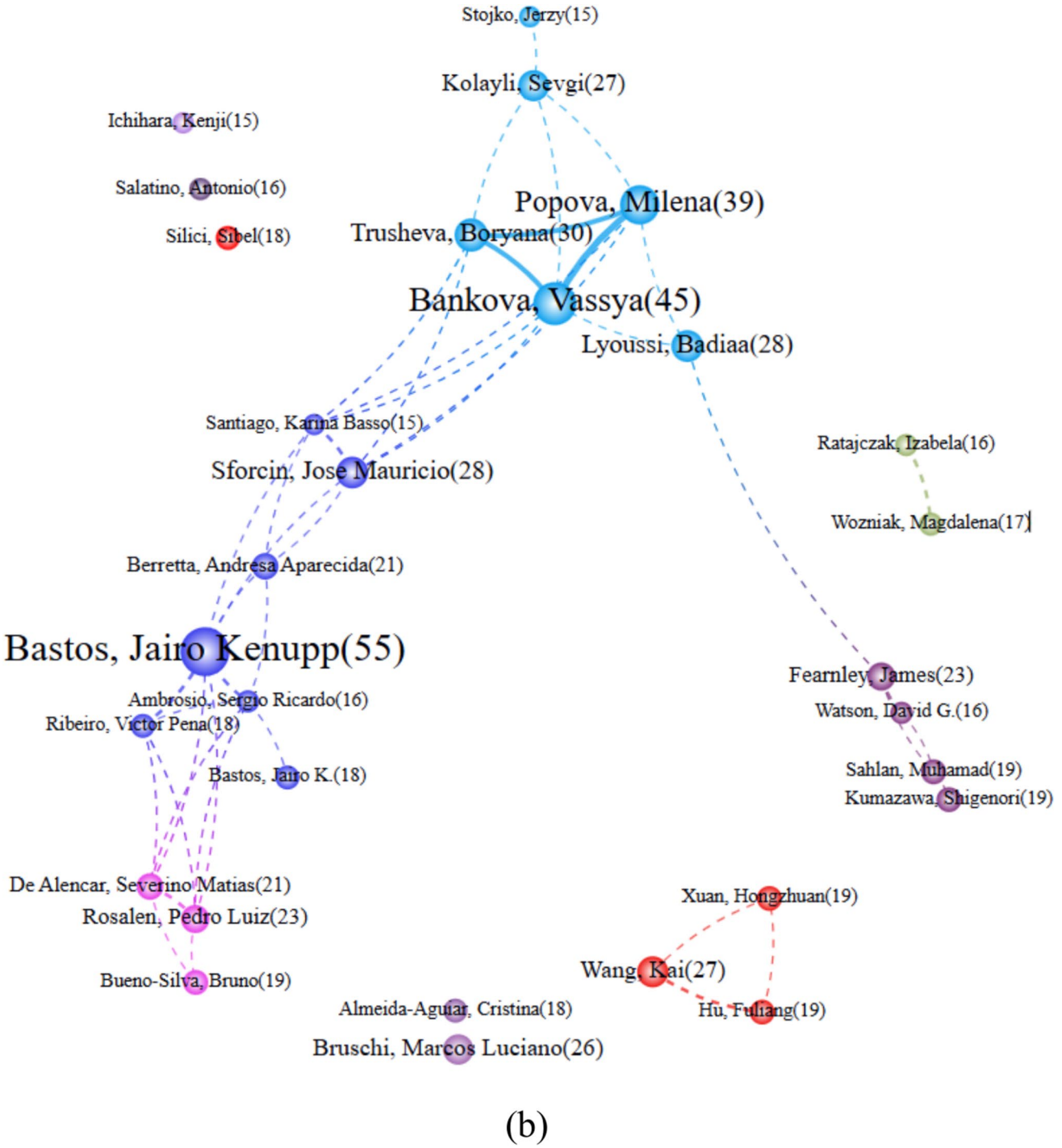


Fig. 4 (continued)

Among seven review articles, five papers, including "Recent Advances in the Chemical Composition of Propolis" (Top1, 486 citations), "Honey, Propolis, and Royal Jelly: a comprehensive review of its biological actions and health benefits"(top2, 439 citations), and "Composition and functional properties of propolis (bee glue): A review" (top3, 352 citations), "Biological Properties and Therapeutic Applications of Propolis" (top7, 307 citations), "Therapeutic Properties of Bioactive Compounds from Different Honeybee Products" (top9, 281 citations) were recognized for its summaries of propolis' chemical constituents, biological and therapeutic properties. Furthermore, one of the seven review papers, "Antibacterial Properties of Propolis" (top4, 322 citations), focused on propolis's antibacterial and

Table 3 Top 10 most prolific authors in global propolis research (2014–2024): publications, affiliations, and total citations

Rank	Author	Documents	Institution	Citations
1	Bastos, Jairo Kenupp	55	University of São Paulo	542
2	Bankova, Vassya	45	Bulgarian Academy of Sciences	1396
3	Popova, Milena	39	Canterbury Christ Church University	1270
4	Trusheva, Boryana	30	Bulgarian Academy of Sciences	912
5	Sforcin, Jose Mauricio	28	São Paulo State University	604
6	Lyoussi, Badiaa	28	Sidi Mohamed Ben Abdellah University	661
7	Wang, Kai	27	Chinese Academy of Agricultural Sciences	1495
8	Kolayli, Sevgi	27	Karadeniz Technical University	442
9	Bruschi, Marcos Luciano	26	State University of Maringa	391
10	Fearnley, James	23	Apiceutical Research Centre	625

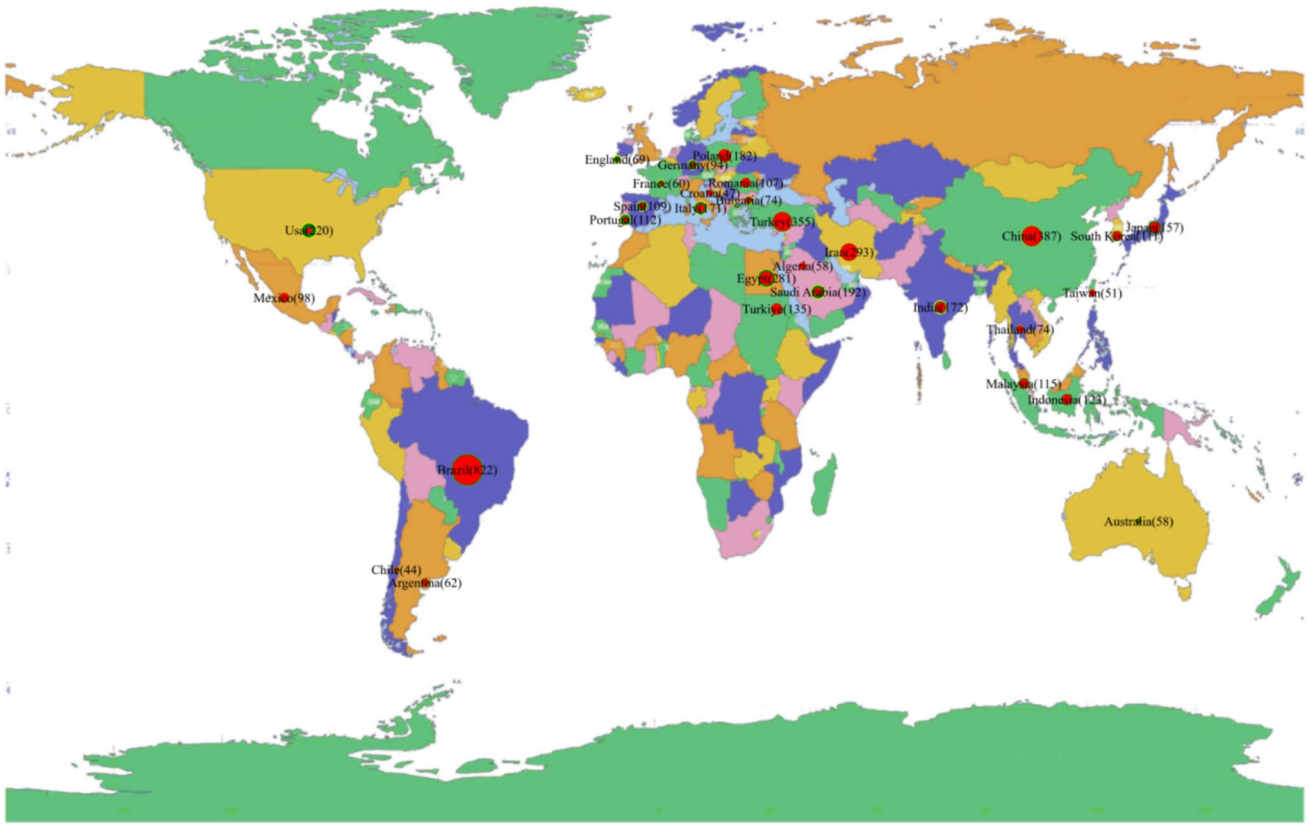


Fig. 5 Geographic distribution map of countries/regions in global propolis research (2014–2024)

antioxidant properties. In addition, another one of the the seven review papers, "Chrysin: Sources, beneficial pharmacological activities, and molecular mechanism of action" (top8, 286 citations), summarized the biological activities and pharmacological effects and its molecular mechanism of flavone chrysin, which occurred naturally in propolis.

Among three research articles, "FTIR analysis and quantification of phenols and flavonoids of five commercially available plants extracts used in wound healing" (top5, 320 citations) analyzed the amount of phenols and flavonoid compounds used in wound healing from propolis and its antioxidant activity, while "Antioxidant Activity of Quercetin and Its Glucosides from Propolis: A Theoretical Study" studied the antioxidative properties of quercetin and its glucosides from Propolis in the gas, ethanol and water phases from theoretical aspect. Notably, there was one research paper, "Improving functional properties of chitosan films as active food packaging by incorporating with propolis" prepared chitosan films incorporated with polyphenol rich propolis extract. The antioxidant activity and antibacterial

Table 4 Top 10 most cited articles in global propolis research (2014–2024): total citation counts in journals (research in web of science)

Name	Citations
Recent Advances in the Chemical Composition of Propolis	486
Honey, Propolis, and Royal Jelly: A Comprehensive Review of Their Biological Actions and Health Benefits	439
Composition and functional properties of propolis (bee glue): A review	352
Antibacterial Properties of Propolis	322
FTIR analysis and quantification of phenols and flavonoids of five commercially available plants extracts used in wound healing	320
Improving functional properties of chitosan films as active food packaging by incorporating with propolis	318
Biological Properties and Therapeutic Applications of Propolis	307
Chrysin: Sources, beneficial pharmacological activities, and molecular mechanism of action	286
Therapeutic Properties of Bioactive Compounds from Different Honeybee Products	281
Antioxidant Activity of Quercetin and Its Glucosides from Propolis: A Theoretical Study	256

performance of different propolis concentrations were evaluated. The results confirmed the advantages of adding propolis extract to chitosan films and demonstrated the potential of these modified films to serve as active food packaging. This research was closely related to the antioxidant and antimicrobial properties of propolis.

In general, the top 10 articles addressed the three issues of propolis: chemical composition, biological and therapeutic properties, application potential in food package and reflected the research landscape and trend of propolis.

Keyword Analysis

The research focus could be identified through journal and keyword analysis, which enables deeper understanding of the core research themes.

The ten most frequently occurring keywords were presented in Table 5. The data revealed that "propolis" ($n = 1{,}948$), "antioxidant" ($n = 199$), and "antioxidant activity" ($n = 183$) were the three most prominent terms, indicating propolis and its antioxidant properties as the strong research focus.

The keyword heatmap of propolis (Fig. 6) displayed high-frequency terms in its research, including "antioxidant", "antibacterial", "Inflammation", "chemical composition", and "bioactivity", which demonstrated that its pharmaceutical research became increasingly prominent.

Table 5 Top 10 most frequent keywords in Global Propolis Research (2014–2024): number of documents mentioned

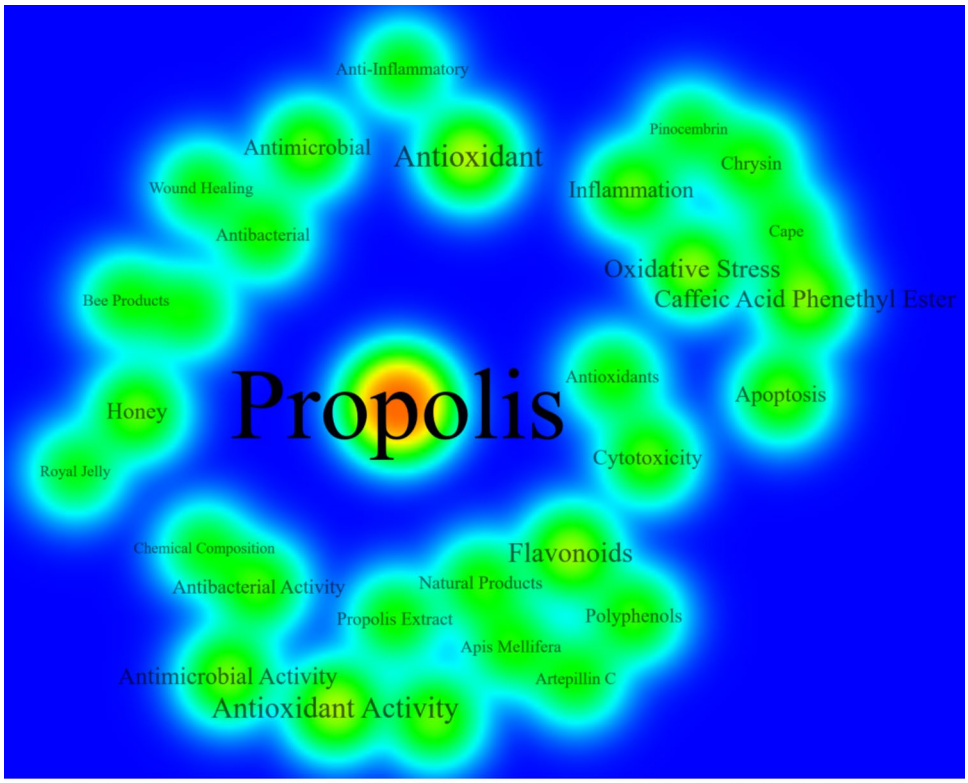
Keywords	Documents
Propolis	1948
Antioxidant	199
Antioxidant Activity	183
Flavonoids	161
Oxidative Stress	147
Caffeic Acid Phenethyl Ester	138
Antimicrobial Activity	120
Phenolic Compounds	110
Inflammation	109
Honey	108

Discussion

General Information

Bibliometric analysis with ITGInsight software was employed to systematically analyze 4,215 publications of propolis between 2014 and 2024 in this study. The comparison reveals that, although the thematic evolution, international collaboration, and interdisciplinary integration of propolis partly mirror those of other natural products, conspicuous gaps remain. For instance, Stefanis et al. (2023) likewise identified "antioxidant" and "antibacterial" as high-frequency keywords in their bibliometric analysis of honey, underscoring a strong convergence of research hotspots among bee-derived natural products.

However, the international co-authorship rate for honey exceeds 15 percent, far above the 6.8 percent recorded for propolis in the present study, highlighting comparatively weak multinational collaboration in propolis research. This deficit likely stems from inconsistent terminology and strongly regional research traditions. Based on it, future research on propolis should place greater emphasis on international collaboration. By establishing unified terminology standards and breaking down traditional regional barriers, deeper cooperation among research teams across multiple countries and institutions can be fostered. This is expected to enhance the global alignment of propolis



(a)

Fig. 6 Keyword heatmap of global propolis research (2014–2024). The numbers in parentheses indicate the frequency of occurrence between 2014 and 2024

research, thereby promoting comprehensive advancement and breakthroughs in the field.

In contrast, the current dataset showed that research on propolis had already accumulated substantial information regarding the identification of active components and the validation of their biological functions, yet the depth of mechanistic investigation remained limited. Although existing mechanistic studies had explored pathways such as nuclear factor kappa B (NF kappa B) regulation and the nuclear factor erythroid 2 related factor 2 antioxidant response element (Nrf2 ARE) signaling pathway, which are related to the antioxidant effects of propolis, such in depth molecular level research was still relatively scattered. Keywords relating to Mechanism, such as "signaling pathway," "molecular target," and "protein expression regulation", accounted for only 12 percent of the high frequency terms. Future studies could preferentially focus on standardized propolis extracts and integrate multi omics approaches such as transcriptomics and proteomics to systematically map the molecular targets and signaling networks of propolis in disease models.

Annual Publication Output Trend

The number of publications on propolis has been continuously increasing. This sustained growth suggests that the depth and breadth of propolis research will keep expanding, potentially giving rise to innovations in areas such as the exploration of active components (new functions of flavonoids and phenolic acids), innovation in application scenarios (development of functional foods), and breakthroughs in disease treatment mechanisms (molecular mechanisms of immunomodulatory and antitumor effects). This anticipated development trend may attract more specialized research funding, interdisciplinary talent, as well as increased attention from related industries such as pharmaceuticals and food. This expansion pattern appeared linking to multiple factors, such as wider accessibility afforded by open-access journals (Momeni et al. 2021), heightened attention toward natural agents' medical potential triggered by the COVID-19 pandemic (Ripari et al. 2021; Dilokthornsakul et al. 2022).

National co-authorship analysis reveals that research outputs in this field are primarily from Brazil, followed by China, Turkey, Iran, and Egypt. The most productive and influential researchers, such as Jairo Kenupp Bastos, who is affiliated with institutions in Brazil, and Vassya Bankova, who is affiliated with institutions in Bulgaria, are well recognized in this field. However, publishers of renowned journals in this field are mostly concentrated in European and North American countries, with key publication platforms including Molecules and Journal of Apicultural Research. The most highly cited papers originate from China, Malaysia,

Pakistan, and Saudi Arabia, indicating the high quality of these publications and their significant reference value.

In terms of cooperation between countries/regions, cross-national collaborations are mainly limited to small-scale interactions between Brazil and its neighboring countries. Direct cooperation among other core contributing countries, such as China and Turkey, is relatively rare, with cross-national co-authored papers accounting for less than 7% of the total global publications in this field. Similarly, while internal cooperation among members of the same research team is close, collaboration between members of different teams remains scarce.

To help propolis research overcome existing bottlenecks (e.g., insufficient depth in mechanistic studies and weak interdisciplinary integration) and accelerate innovation in cutting-edge directions such as nanotechnology applications and functional food development, it is urgent for scholars worldwide to break down academic and geographical barriers and engage in in-depth cooperation in propolis research.

Research Hotspots

A hotspot refers to a scientific theme or emerging topic within a given period (Chen 2006). The analysis of high-frequency keywords can help identify hot spots in a certain research field.

According to the analysis of high-frequency keywords (Top 10 keywords: Propolis, Antioxidant, Antioxidant Activity, Flavonoids, Oxidative Stress, Caffeic Acid Phenethyl Ester, Antimicrobial Activity, Phenolic Compounds, Inflammation, Honey), the core research focus in propolis studies has consistently centered on its chemical components and bioactivities (antioxidant, antimicrobial and anti-inflammation activities) and related mechanisms. The prominent frequency of the keywords “antioxidant”, “antioxidant activity” and “oxidative Stress” confirms the central position of “antioxidant property” within the propolis research field. Furthermore, it highlights a significant congruence between the inherent bioactivity of propolis and the practical requirements of the human health and food sectors. Boufadi et al (2018) demonstrated that propolis extract can restore homeostasis and repair organ damage caused by oxidative stress, while research indicated that propolis-based films and related composite films extend the shelf life of perishable foods like fruits, vegetables, meat, and seafood due to its antibacterial and antioxidant properties (Siripatrawan and Vitchayakitti 2016).

The Top 10 Most Cited Publications

The top 10 articles of propolis focused on the three topics: chemical composition(for example: flavonoids), bioactive properties(such as antioxidant, antibacterial activities), application in food package, it suggested that the antioxidant, antibacterial properties of propolis were one of the main research hot topic, which played a key role in its therapeutic effect and extended to the food package application. The above summaries were corroborated by the keywords analysis (Top 10 keywords: Propolis, Antioxidant, Antioxidant Activity, Flavonoids, Oxidative Stress, Caffeic Acid Phenethyl Ester, Antimicrobial Activity, Phenolic Compounds, Inflammation, Honey) and research hotspot analysis.

Implications of Bibliometric Analysis for Policy and Decision-Making

It provides critical evidence for policy and decision-making in healthcare and industrial sectors in propolis field based on systematic bibliometric analysis. For instance, exploration of propolis' therapeutic properties highlights its antimicrobial, anti-inflammatory and wound healing effects (Balasubramaniam et al. 2025), while propolis-based films can extend the shelf life of perishable foods (Segueni et al. 2023). It fosters policy and decision-makers to roll out more policies and funding to support propolis research and application.

Theoretical and Practical Implications of Bibliometric Analysis

Bibliometric analysis was systematically applied to examine thematic evolution, uncover under-explored areas, and monitor emerging patterns. Theoretically, it not only deepened the foundational understanding of propolis studies but also established a transferable analytical framework applicable to other natural products. Practically, the use of ITGInsight facilitated multi-dimensional visualization and in-depth interpretation of literature data, empirically validating the efficacy of bibliometric methods in complex research domains. Crucially, this study fundamentally expanded the application scope and research frontiers of bibliometrics, thereby enhancing its practical value in interdisciplinary contexts.

Strengths and Limitations

This study had two important strengths. Firstly, it provided the first systematic bibliometric analysis of propolis research, offering researchers a valuable reference resource of the current landscape and future research directions. Secondly, the research findings were derived through the application of ITGInsight. It enabled sophisticated text mining, multidimensional data visualization and dynamic trend detection, which were crucial for comprehensively mapping the complex evolution of propolis research over the decade. Nevertheless, certain limitations must be acknowledged. Primarily, only the Web of Science (WoS) database

was consulted, whereas other major medical databases such as Scopus and Embase were excluded. Additionally, publications related to propolis from 2025 were excluded from analysis due to incomplete data during the database search (conducted on December 9, 2024), this omission may cause incompleteness in the dataset.

Conclusion

Based on 4,215 propolis-related records retrieved from the Web of Science Core Collection (2014–2024), this study presents the first systematic bibliometric landscape of the field using ITGInsight. Brazil, China and Turkey dominate scholarly output, with the University of São Paulo leading at 227 publications. Antioxidant, flavonoid and antimicrobial effects remain perennial hotspots. Our work fills the methodological gap in quantitative propolis research and demonstrates the transferability of ITGInsight for mapping other natural products. Looking ahead, the biomedical potential of propolis—especially its antioxidant and antimicrobial properties—remains a highly promising direction for therapeutic development. Meanwhile, the integration of propolis-derived compounds into biodegradable and active food packaging is emerging as a dynamic new frontier, offering innovative strategies for food preservation.

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Data Availability This study is a bibliometric analysis based on publicly accessible literature data from ITGInsight, and no additional datasets or materials were generated. Thus, the availability of data and material statement is not applicable.

Declarations

Ethics Approval Not applicable.

Competing interests The authors have no relevant financial or non-financial interests to disclose.

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