

EXTRA VIRGIN OLIVE OIL: A MAPPING STUDY OF ITS BIOLOGICAL EFFECTS

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ABSTRACT

Extra Virgin Olive Oil (EVOO) is known for its antioxidant, anti-inflammatory, and cardioprotective effects. However, a comprehensive analysis of research trends is still needed to identify funders and collaboration. Therefore, this study aims to examine literatures on EVOO's biological activities, identifying key contributors, trends, and emerging themes. Data from 894 studies (2004–2024) were extracted from Scopus and analyzed using Scopus Analyser and VOSviewer. The analysis included publication trends, co-authorship networks, keyword co-occurrence, top sponsors, most cited articles and citation patterns by country. Results show steady growth in EVOO research, peaking around 2020. Europe, in particular, Spain and Italy, emerges as the strongest contributor to EVOO research supported by the European Commission and national institutions. The therapeutic effects of EVOO were emphasised in highly cited articles in literature, specifically in the context of cardiovascular protection, neuroprotection, and prevention of the onset of diseases, particularly oleocanthal and hydroxytyrosol appearing as bioactive compounds. Co-authorship analysis reveals clusters of influential researchers, highlighting cross-field collaborations. Keyword indicates a strong focus on antioxidant properties, phenolic compounds and the Mediterranean diet. This study maps the EVOO research landscape, emphasizing its health benefits and scientific significance. By identifying leading studies and emerging trends, it serves as a reference for future research, reinforcing EVOO's role in nutrition and disease prevention.

KEYWORDS: Extra virgin olive oil, cancer, obesity, heart disease, bibliometric analysis

INTRODUCTION

Extra virgin olive oil (EVOO), a cornerstone of the Mediterranean diet, has drawn significant attention for its documented health benefits and biological activities. EVOO is obtained by the cold mechanical pressing of olives, which leads to presence of the natural phenolic compounds, vitamins, and unsaturated fatty acids. EVOO differs in composition and benefits from other edible oils (1,2). Its chemical profile has been linked to pharmacological effects, including antioxidant (3,4), anti-inflammatory (5) and cardioprotective activities (6).

Bioactive compounds such as polyphenols, particularly hydroxytyrosol and oleuropein (7), have drawn strong research interest. These compounds show potent antioxidant activity by scavenging free radicals and reducing oxidative stress, a key factor in chronic diseases such as cancer (8), diabetes (9), and neurodegeneration (7).

Beyond nutrition and therapy, EVOO research also addresses cultural, economic, and agricultural dimensions. Its production and consumption are deeply tied to Mediterranean traditions, while also representing modern health science (10). Expanding global demand has further advanced extraction technologies, strengthened quality control, and broadened investigations into its biological applications (11,12).

Although many studies have examined EVOO, few bibliometric analyses have systematically reviewed its scientific landscape and global research trends. Bibliometric research is a useful method to evaluate research trends, key contributors, and to reveal emergent topics in the area (13). By using this approach, the results obtained will be very useful for researchers in EVOO and its biological activities.

This study aims to address the following research questions (RQ):

RQ 1: What are the publication trends of the study by year?

RQ 2: Who are the top sponsors in the area of EVOO?

RQ 3: Who writes the most-cited articles related to EVOO?

RQ 4: How is the distribution of co-authorship?

RQ 5: What are the keywords associated with the study?

RQ 6: How is the distribution of citations by country?

This paper is organized as follows. First, it reviews and critically evaluates previous literature reviews on the biological activities of EVOO. The materials and methods employed in the present study are then described. Subsequently, the results of the bibliometric analysis are presented, including publication trends, most-cited articles, co-authorship networks, keyword analysis, and contributing countries to EVOO research, followed by a discussion of the findings. Finally, the concluding section summarizes the key results and their implications.

MATERIALS AND METHODS

Bibliometrics involves the integration, management, and analysis of bibliographic data derived from scientific publications (14). This field consists of general descriptive statistics, such as publishing journals, publication years, and primary author classifications (15) as well as advanced techniques such as document co-citation analysis. A successful literature review involves an iterative process of selecting relevant keywords, searching literature, analyzing findings, compiling a comprehensive bibliography, and generating reliable outcomes.

This study focused on high-impact publications that offer critical insights into the theoretical frameworks shaping the research field. To ensure data reliability, publications were retrieved from the Scopus database. Only peer-reviewed journal articles were included, while books were excluded to maintain quality. Elsevier's Scopus, recognized for its broad coverage, enabled the collection of publications from January to December 2024. Scopus is widely recognized for its broad journal coverage, particularly in the biomedical and natural sciences, and for providing high-quality, standardized bibliographic metadata that support robust bibliometric analyses. Comparative studies have shown that Scopus indexes a substantially larger number of journals than Web of Science and provides reliable citation data suitable for mapping research landscapes (16). Therefore, this study only uses the Scopus database. The bibliometric analysis process applied in this study is outlined in Figure 1 that constructed based on PRISMA (17).

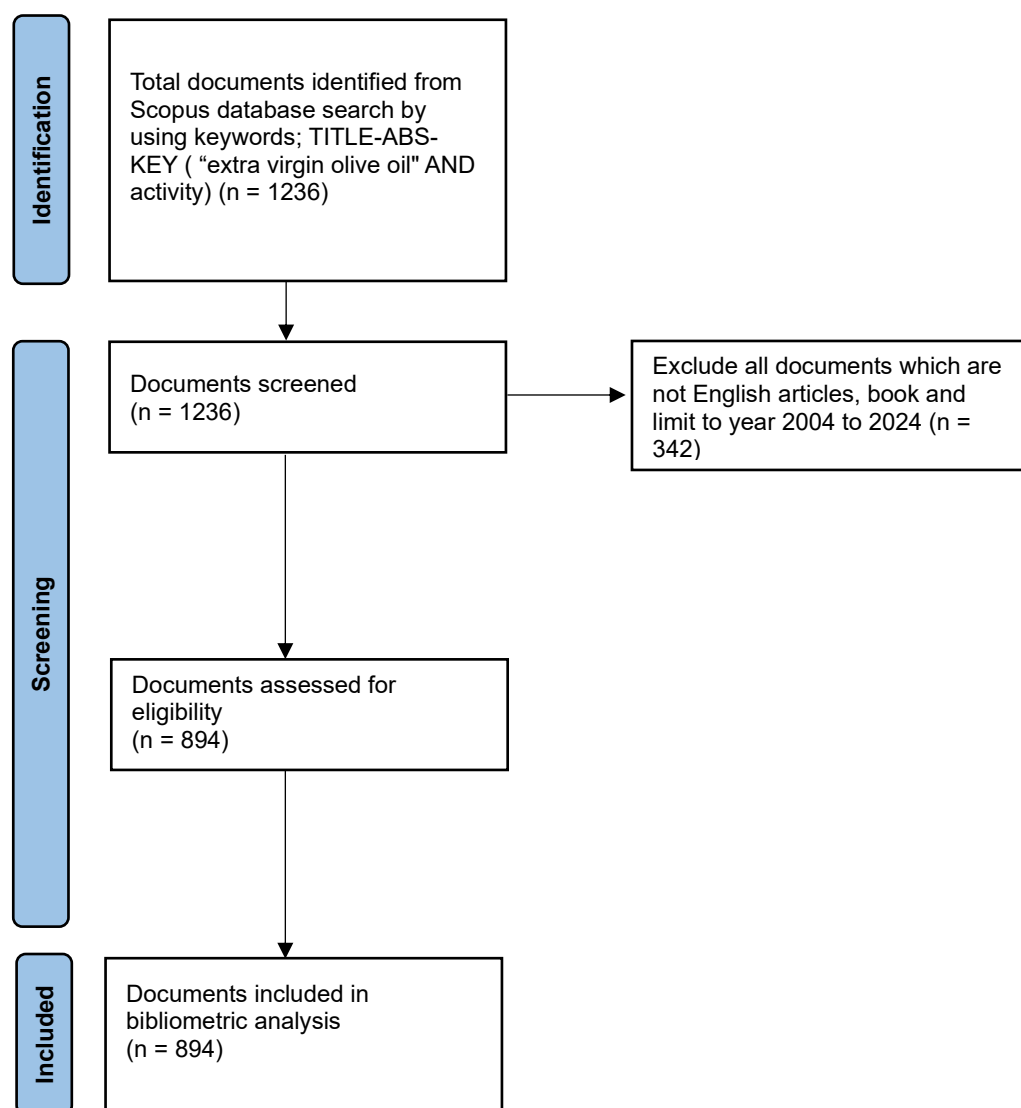


Figure 1. PRISMA flow chart for bibliometric analysis.

Data search strategy

The study was conducted by querying the Scopus database using the search term TITLE-ABS-KEY ("extra virgin olive oil" AND activity), resulting in 1236 articles. The final search string as shown in Table 1A was further refined to 894 articles, which were used for bibliometric analysis. The study incorporated all articles from the Scopus database related to EVOO and its biological activities from 2004 to December 2024 based on the criteria presented in Table 1B.

Table 1A. The search string for the Scopus database. Access date: January 2025

Stage	Search string
Initial	TITLE-ABS-KEY ("extra virgin olive oil" AND activity)
Final	TITLE-ABS-KEY ("extra virgin olive oil" AND activity) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp")) AND (LIMIT-TO (PUBYEAR , 2004) OR LIMIT-TO (PUBYEAR , 2005) OR LIMIT-TO (PUBYEAR , 2006) OR LIMIT-TO (PUBYEAR , 2007) OR LIMIT-TO (PUBYEAR , 2008) OR LIMIT-TO (PUBYEAR , 2009) OR LIMIT-TO (PUBYEAR , 2010) OR LIMIT-TO (PUBYEAR , 2011) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2023) OR LIMIT-TO (PUBYEAR , 2024)) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SRCTYPE , "j"))

Table 1B. The criteria for selection in the search process.

Criterion	Inclusion	Exclusion
Language	English	Non-English
Document type	Article	Non-article
Literature type	Journal (Article)	Book

Data cleaning

Prior to analysis, the bibliographic data retrieved from the Scopus database were subjected to a data-cleaning process to ensure accuracy and consistency. Only records with complete bibliographic information (title, authors, year, source, and keywords) were retained for analysis. Author identification and disambiguation were primarily based on Scopus' built-in Author Identifier system, which assigns unique identifiers to authors using metadata such as co-authorship patterns, affiliations, and publication history (16). This approach minimizes ambiguity arising from variations in author names. Bibliometric mapping and network analyses were conducted using VOSviewer, which applies standardized preprocessing rules and relies on database-level author identifiers for constructing co-authorship and citation networks.

Data analysis

VOSviewer is a software tool used to build and visualize bibliometric networks. These networks may represent journals, researchers, or individual publications and are applied to map and analyze their relationships. VOSviewer provides multiple visualization options, including network, overlay, and density views, which allow detailed exploration of large datasets. It is widely applied in academic research for bibliometric analysis and science mapping (18).

For this study, datasets in Plain Text format containing publication year, title, author names, journal, citations, and keywords were extracted from the Scopus database covering January 2004 to December 2024. These datasets were analyzed using VOSviewer version 1.6.19. By applying clustering and mapping techniques, the software facilitated the creation and assessment of bibliometric maps.

RESULTS

Year of publication and top sponsors

The data on EVOO and its biological effects showed a consistent upward trend from 2004 to 2024 (Figure 2A). Between 2004 and 2012, the number of publications increased gradually from less than 10 documents per year to approximately 20. A noticeable rise began in 2013, followed by steady growth through 2017, when output reached around 50 publications per year.

A sharp increase was observed between 2018 and 2020, during which the annual output peaked at approximately 100 documents in 2020, which the most productive year within the 20-year period. After this peak, the publication trend declined in 2021 and 2022, although the output remained higher than pre-2018 levels. In 2023, the number of documents dropped further but increased again in 2024, indicating a partial rebound in research interest.

Apart from that, the leading sponsors were European institutions, such as the European Commission, the European Regional Development Fund, and national-level ministries and agencies in Spain, Italy, and France, as shown in Figure 2B. The European Regional Development Fund ranked first with 66 publications, followed by the Instituto de Salud Carlos III with about 45 articles. Other major sponsors included the European Commission (29 articles), Ministerio de Ciencia e Innovación (26 articles), Junta de Andalucía (25 articles), Centro de Investigación Biomédica en Red-Fisiopatología de la Obesidad y Nutrición (20 articles), and Generalitat de Catalunya (16 articles). The National Institutes of Health (USA) appears as the only non-European funder among the top ten, with 24 articles.

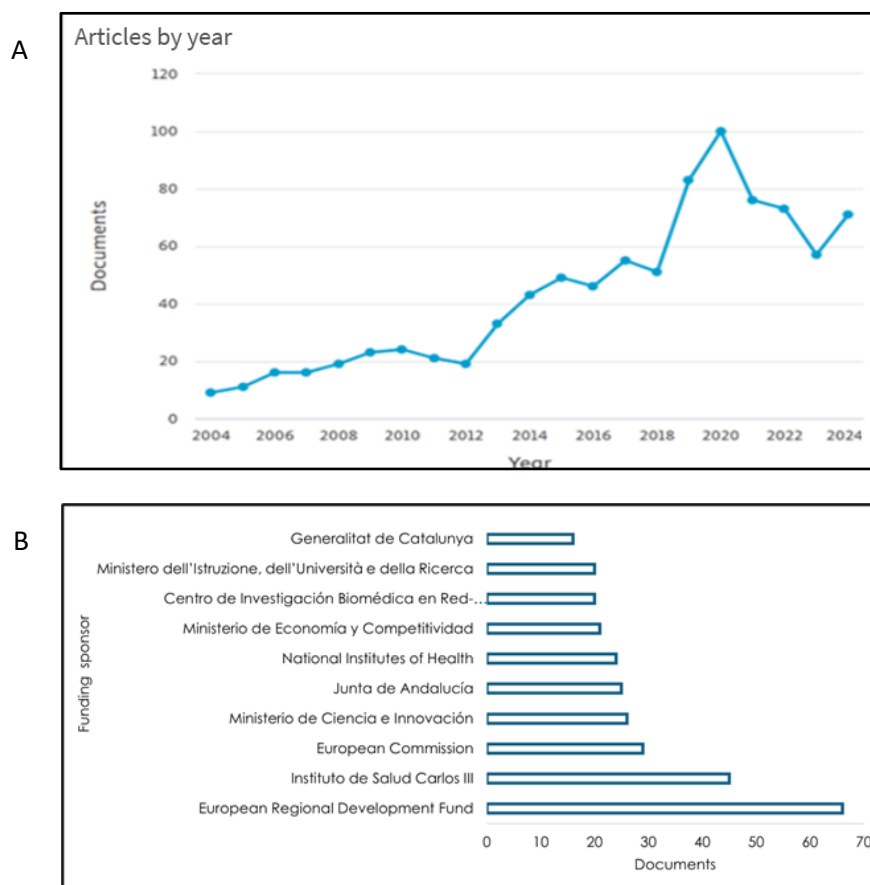


Figure 2. Temporal analysis and financial support of EVOO research.

(A) Annual Publication Trends (2004–2024): This panel illustrates the evolution of scientific output concerning the biological effects of EVOO. The field experienced a gradual inception (2004–2012), followed by a steady growth phase (2013–2017) that culminated in a significant surge between 2018 and 2020. Research activity reached its historical peak in 2020 with approximately 100 documents, followed by a post-peak stabilization and a recent rebound in 2024.

(B) Major Funding Contributors: A distribution of the top-ranking sponsoring organizations. This chart identifies the key institutional and governmental bodies providing the financial framework for the research documented in Panel A.

Most cited articles

The most cited articles related to EVOO and Its Biological Activities highlight its significant role in promoting human health, with a strong emphasis on its anti-inflammatory, antioxidant, neuroprotective, and cardiometabolic benefits as shown in Table 2. The most cited research was "Ibuprofen-like activity in extra-virgin olive oil" by Beauchamp et al. (2005), published in *Nature* with 817 citations. The study demonstrated that EVOO contains oleocanthal, a phenolic compound with anti-inflammatory properties like ibuprofen. This groundbreaking discovery linked EVOO to potential therapeutic effects, particularly for inflammation-related diseases.

Table 2. Most cited articles to EVOO and Its related biological activities

Authors	Title	Year	Source title	Cited by
Beauchamp et al. (19)	Ibuprofen-like activity in extra-virgin olive oil	2005	Nature	817
Martínez-González et al. (20)	Benefits of the Mediterranean Diet: Insights from the PREDIMED Study	2015	Progress in Cardiovascular Diseases	568
Salas-Salvadó et al. (21)	Prevention of diabetes with mediterranean diets: A subgroup analysis of a randomized trial	2014	Annals of Internal Medicine	503
Martínez-Lapiscina et al. (22)	Mediterranean diet improves cognition: The PREDIMED-NAVARRA randomised trial	2013	Journal of Neurology, Neurosurgery and Psychiatry	498
Romani et al. (23)	Health effects of phenolic compounds found in extra-virgin olive oil, by-products, and leaf of olea europaea L.	2019	Nutrients	275
Carrasco-Pancorbo et al. (24)	Evaluation of the antioxidant capacity of individual phenolic compounds in virgin olive oil	2005	Journal of Agricultural and Food Chemistry	264
Bogani et al. (25)	Postprandial anti-inflammatory and antioxidant effects of extra virgin olive oil	2007	Atherosclerosis	258
Abuznait et al. (26)	Olive-oil-derived oleocanthal enhances β -amyloid clearance as a potential neuroprotective mechanism against Alzheimer's disease: In vitro and in vivo studies	2013	ACS Chemical Neuroscience	240
Martinez-Lapiscina et al. (27)	Virgin olive oil supplementation and long-term cognition: The Predimed-Navarra randomized, trial	2013	Journal of Nutrition, Health and Aging	228
Babio et al. (28)	Mediterranean diets and metabolic syndrome status in the PREDIMED randomized trial	2014	CMAJ	226

Similarly, a clinical trial from PREDIMED further highlights EVOO's importance. Studies include "Benefits of the Mediterranean Diet: Insights from the PREDIMED Study" (20) with 568 citations and "Mediterranean diet improves cognition: The PRED-IMED-NAVARRA randomized trial" (22) with 498 citations, which demonstrate the role of EVOO in cardiovascular protection and cognitive health. Another significant contribution, "Prevention of diabetes with Mediterranean diets" (21), with 503

citations, highlights EVOO's ability to reduce the risk of diabetes, particularly when consumed as part of a Mediterranean dietary pattern.

The postprandial anti-inflammatory and antioxidant effects of EVOO are also well-documented by Bogani et al., (25) published in *Atherosclerosis* (258 citations). The article emphasizes its role in reducing oxidative stress after meals which is particularly relevant for cardiovascular health. A study like "Olive-oil-derived oleocanthal enhances β -amyloid clearance" (26) in *ACS Chemical Neuroscience* with 240 citations, has shown the EVOO's neuroprotective potential, demonstrating oleocanthal's ability to clear β -amyloid plaques associated with Alzheimer's disease. Research on phenolic compounds in EVOO shows their potent antioxidant activity and role in disease prevention. Key studies include Romani et al., (23), titled 'Health Effects of Phenolic Compounds' (Nutrients, 275 citations), and Carrasco-Pancorbo et al., (24), 'Evaluation of the Antioxidant Capacity of Individual Phenolic Compounds' (Journal of Agricultural and Food Chemistry, 264 citations).

Co-Authorship, keywords, citation countries related to EVOO Research

The co-authorship analysis generated using VOSviewer for research related to *Extra Virgin Olive Oil and Its Biological Activities* provides a visual representation of the collaborative relationships among researchers in the field (Figure 3A). This network graph reveals key authors, their collaborative clusters, and the strength of their connections based on co-authored publications. Please ensure the name of the figure. It is confusing.

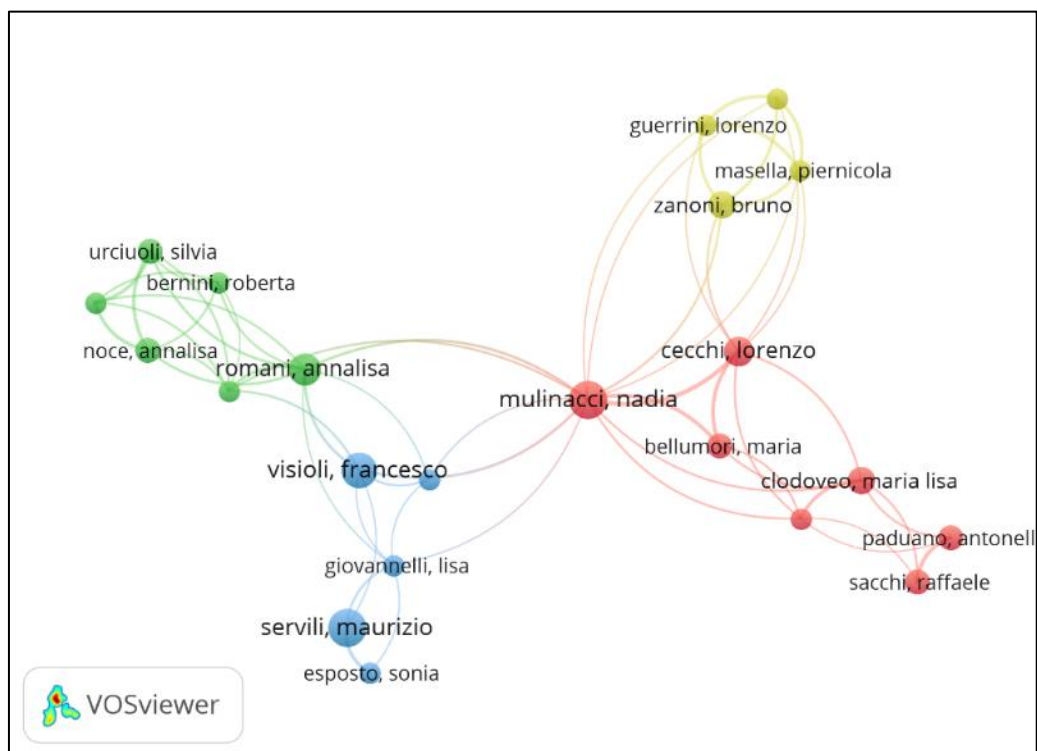
The analysis shows four distinct clusters of researchers, each represented by a different colour (green, blue, red, and yellow). The clusters indicate groups of researchers who frequently collaborate. For the red cluster, Mulinacci and Nadia are highly influential figures in this network, with multiple connections to other authors, including Cecchi, Lorenzo, Clodoveo, Maria Lisa, Bellumori, and Maria. This cluster focuses on collaborative work regarding the chemical properties and health effects of EVOO, particularly in areas related to phenolic content and biological activity. The size of Mulinacci's node and its central position reflect a high occurrence (frequency of co-authored papers) and strong total link strength (number and strength of collaborative ties). Green Cluster reveals Romani and Annalisa as the central authors. This cluster includes authors like Bernini, Roberta, Noce, Annalisa, and Urciuoli, Silvia, showing a dense network of collaborations. Romani and her collaborators are closely connected, indicating frequent joint publications. This cluster represents research focused on the phenolic compounds in EVOO and their antioxidant properties. Blue cluster focuses on Servili, Maurizio and Visioli, Francesco as the central authors. These authors have strong collaborative ties, with co-authors like Esposto and Sonia, as well as Giovannelli and Lisa. This group appears to focus on EVOO's role in cardiovascular health, postprandial effects, and chemical profiling. The nodes for Servili and Visioli are prominent, showing high occurrences and strong total link strength. In the yellow cluster, Guerrini and Lorenzo emerged as the central authors. This smaller cluster also included Masella, Piernicola, Zanoni, and Bruno. The network was less dense than in other clusters, indicating a narrower scope of collaboration, likely centered on specific biochemical or analytical studies.

Figure 3B represents a co-occurrence network analysis that is linked to the keywords. Keywords represent specific terms or concepts that appear in academic publications about EVOO and its biological activities. Each keyword is a node in the network. Occurrences indicate how many times each keyword appears across all analysed publications. For example, the keywords "antioxidant activity" appear 219 times, while "extra virgin olive oil" appears 515 times. This metric helps identify the most frequently discussed topics in the field. Apart from that, "extra virgin olive oil" has a total link

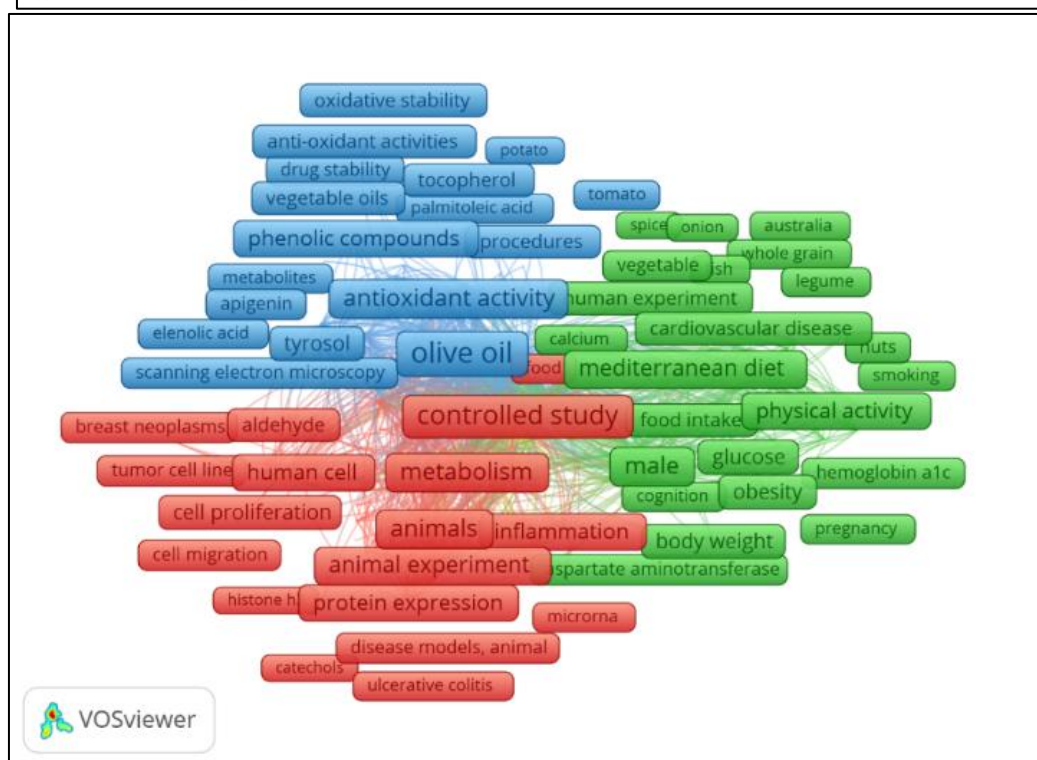
strength of 14,452, suggesting it is strongly connected to many other concepts in the research. A higher total link strength indicates that the keyword frequently appears alongside other keywords. The relationships of the data suggest "Extra virgin olive oil" has the strongest network presence (515 occurrences, 14,452 total link strength), indicating it is the central concept connecting various research aspects. "Antioxidant" and "antioxidant activity" both show high occurrences (170 and 219) and substantial link strengths (5,161 and 5,879), suggesting these are major research focuses strongly connected to other topics. "Mediterranean diet" demonstrates a significant presence (140 occurrences, 5,208 link strength), indicating frequent research linking it to extra virgin olive oil's health benefits. "Hydroxytyrosol" (139 occurrences, 4,582 link strength) and "oleocanthal" (79 occurrences, 2,542 link strength) represent key bioactive compounds frequently studied in connection with other aspects of olive oil research.

The data in Figure 3C presents three key metrics across 33 countries: the number of documents published, citation counts, and total link strength. The citation counts indicate the research influence of each country. While document count shows research volume, citations reflect the impact and recognition of that research. Italy and Spain emerge as the dominant research hubs in this field. Italy leads with 345 documents and 11,661 citations, followed by Spain with 227 documents and 9,825 citations. This prominence aligns with their status as major olive oil-producing nations. The United States ranks third with 78 documents and 3,946 citations, demonstrating significant research impact despite not being a traditional olive oil producer. South Korea, despite having only 6 documents, garnered 884 citations, suggesting highly influential research. Conversely, Indonesia produced 13 documents but received only 174 citations, indicating potentially lower research impact. The total link strength represents the interconnectedness of research collaboration between countries. Higher values indicate stronger research networks and collaborations. Germany, despite having fewer documents (20) than some countries, shows a high total link strength (99), suggesting strong international research partnerships. Similarly, Tunisia's high total link strength (115) relative to its document count (39) indicates high international collaboration. Mediterranean countries generally show strong performance across all metrics, which is logical given their historical and economic connection to olive oil production. The data reveals that high document counts don't always correlate with high citation numbers or link strength. For example, China produced 24 documents but shows relatively modest citations (769) compared to countries with fewer publications.

A



B



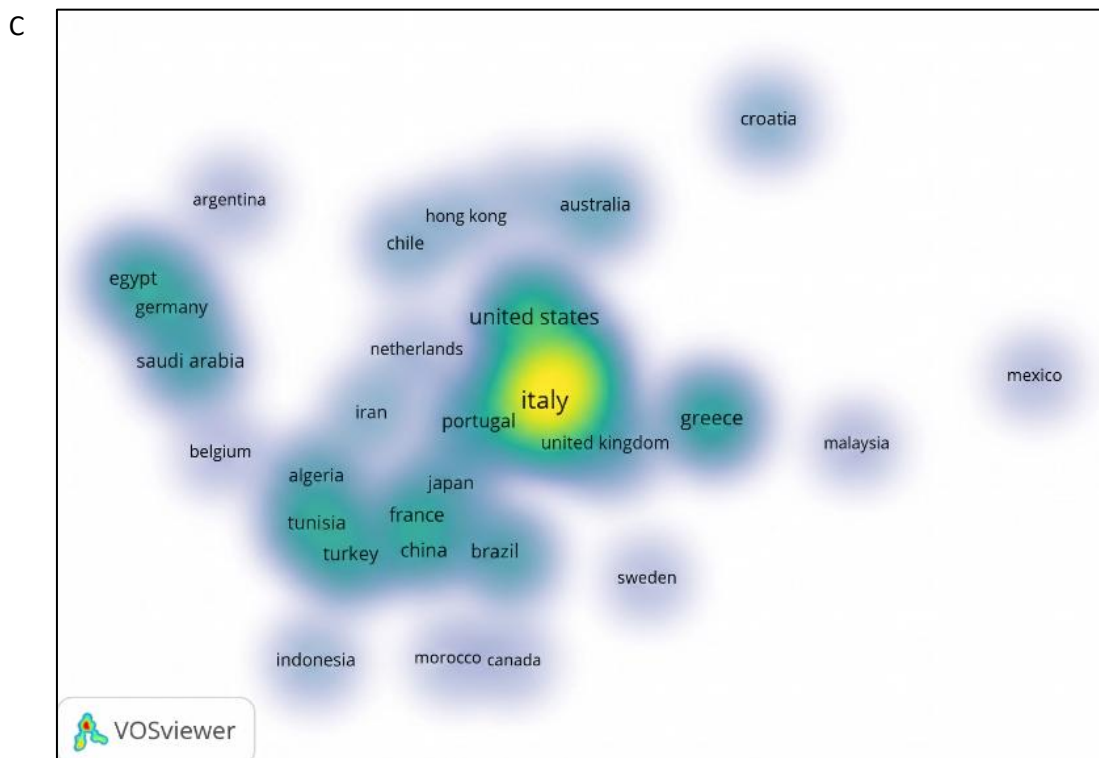


Figure 3. Bibliometric analysis of global research output and collaboration networks. This multi-panel visualization provides a comprehensive overview of the research landscape using VOSviewer.

(A) Co-authorship Network Map: Illustrates the collaborative relationships between key authors in the field. Authors are represented as nodes, where the node size indicates the total number of publications, and the connecting lines represent collaborative ties. Nodes of the same color identify closely linked research clusters or academic groups.

(B) Keyword Co-occurrence Network: Visualizes the thematic structure and prominent research topics. The size of each keyword label corresponds to its frequency of occurrence. Keywords are grouped into three main thematic clusters (red, green, and blue), representing distinct research directions such as metabolism, clinical studies, and chemical properties.

(C) Geographic Citation Density Map: A heat map representing the citation impact of various countries. Regions with higher citation density are highlighted in yellow and bright green, identifying major contributors like Italy and the United States, while cooler blue tones represent emerging or less-cited regions.

DISCUSSION

The upward publication trend observed in this study was consistent with findings from previous bibliometric analyses on EVOO and its biological effects. Shao et al. (2022) reported an exponential increase in global olive oil research output, particularly after 2010 (29). More recent bibliometric mapping of olive bioactivity research further confirms accelerated growth during the past decade, especially in areas related to antioxidant, anti-inflammatory, and cardioprotective effects (29,30). The gradual increase observed between 2004 and 2012 in the present study aligns with the early phase of bioactive compound characterisation, followed by steeper growth as mechanistic and clinical evidence accumulated.

The peak in publications observed in 2020 reflects broader global research priorities during the COVID-19 pandemic. Several studies have documented a surge in nutrition-related research during this period, driven by heightened interest in immune-modulating diets, functional foods, and nutraceuticals as supportive strategies against infectious diseases (31,32). EVOO, rich in polyphenols and monounsaturated fatty acids with anti-inflammatory and immunomodulatory properties, became a frequent subject of investigation within this context. This pandemic-related research acceleration has also been noted across functional food and dietary supplement studies more broadly, explaining the unusually high publication output in 2020 (31–34). Recent reviews highlight expanding research on plant-derived bioactive compounds, precision nutrition, and food-based disease prevention, with oils, polyphenol-rich foods, and traditional dietary patterns receiving increased attention (32,34). The partial decline after 2020, followed by rebound in 2024, may indicate stabilization after pandemic-driven research surges, while sustaining long-term interest in EVOO as a key functional food component.

The predominance of European funding agencies observed in this study was consistent with findings from previous bibliometric analyses on EVOO research. Earlier studies have shown that research output was heavily concentrated in Mediterranean countries, particularly Spain, Italy, and France, where olive cultivation, consumption, and industrial relevance are highest. Shao et al. (2020) reported that Spain and Italy not only lead in publication volume but also benefit from strong institutional and public funding support, which plays a central role in sustaining long-term EVOO research capacity (29). Reviews of functional food research indicate that European framework programs and national ministries have increasingly prioritised plant-based bioactives, Mediterranean diet components, and translational nutrition research (35). The presence of the U.S. National Institutes of Health among the top sponsors suggests growing transatlantic recognition of EVOO as a functional food, but the overall dominance of European funders underscores the close alignment between regional dietary traditions and strategic research investment in the nutraceutical sector (35).

Earlier large-scale bibliometric reviews have consistently shown that the most influential publications are foundational mechanistic and clinical studies establishing the health benefits of EVOO, particularly its anti-inflammatory, antioxidant, cardiometabolic effects (28), diabetes (19), and neurodegenerative disorders (22). A recent bibliometric mapping of olive bioactivity research confirmed that Beauchamp et al.'s discovery of oleocanthal and the PREDIMED clinical trials remain among the most frequently cited studies (19).

In a large-scale bibliometric study of global olive oil literature, Shao et al. (2022) identified “*extra virgin olive oil*,” “*antioxidant activity*,” and “*Mediterranean diet*” as the most frequent and highly interconnected keywords (29), which was similar to the current data. Similarly, a recent bibliometric mapping of olive bioactivity research by Garrido-Romero et al. (2025) reported that phenolic compounds such as *hydroxytyrosol* and *oleocanthal* consistently emerged as core hotspots with strong co-occurrence (30) links to inflammation (36), oxidative stress (36), and cardiometabolic endpoints (30).

The country-level patterns observed in this study closely mirror those reported in previous bibliometric analyses of EVOO research. Large-scale bibliometric studies have consistently identified Italy and Spain as the dominant contributors in terms of publication volume, citation impact, and international collaboration, reflecting their central role in olive cultivation, production, and Mediterranean diet research (29). The strong citation performance of the United States, despite a lower publication

volume, has also been reported previously and is attributed to its emphasis on high-impact clinical, mechanistic, and nutritional studies rather than agricultural research (29).

In contrast, the relatively low research output and citation impact observed in Southeast Asian countries such as Indonesia align with earlier bibliometric findings, which show minimal representation from non-olive-producing regions. This imbalance is largely explained by agro-ecological and cultural factors, which is olive trees (*Olea europaea*) are not native to Southeast Asia (37,38), and regional research priorities traditionally focus on locally dominant oils such as palm and coconut (39,40). Consequently, fewer region-specific dietary intervention studies and limited funding streams exist for EVOO-related research.

Global research on functional foods and nutraceuticals has increasingly shifted toward diet-based prevention of chronic diseases, with a strong focus on plant-derived bioactive compounds. Within this framework, EVOO has emerged as a model functional food due to its high content of phenolic compounds, monounsaturated fatty acids, and their demonstrated biological activity. Recent bibliometric and review studies highlight that antioxidant, anti-inflammatory, cardioprotective, and neuroprotective effects are the dominant biological themes driving EVOO research, consistent with broader trends in functional nutrition science (30).

This trajectory parallels global nutraceutical research priorities that emphasise natural antioxidants, immune-modulating compounds, and dietary strategies for cardiometabolic and neurodegenerative disease prevention (41). Compounds such as hydroxytyrosol and oleocanthal have gained particular attention as bioactives with clinically relevant mechanisms, aligning EVOO research with nutrigenomics, precision nutrition, and evidence-based dietary interventions. Furthermore, the COVID-19 pandemic accelerated interest in functional foods with immunomodulatory and anti-inflammatory properties, reinforcing EVOO's relevance within global nutritional research agendas (33).

CONCLUSION

With the trend of 894 publications, this bibliometric analysis highlights:

1. Growing Research Trends: Sustained publication growth, with the highest peaks in 2020, reflecting heightened scientific interest in EVOO's biological effects.
2. Global Research Landscape: The leading funding bodies include the European Regional Development Fund, Instituto de Salud Carlos III and European Commission, indicating strong European investment in EVOO-related research and development.
3. Most Cited Articles: The most influential publication is "Ibuprofen-like activity in extra-virgin olive oil" by Beauchamp et al. (2005), published in Nature with 817 citations. This indicates its foundational role in linking EVOO to inflammatory properties.
4. Collaborative Networks: Prominent research clusters, particularly led by Mulinacci and Nadia, demonstrate international collaboration and play a pivotal role in advancing the field.
5. Research Focus: Current studies emphasize antioxidant activity, phenolic compounds such as hydroxytyrosol, and Mediterranean diet highlighting the importance of EVOO in disease prevention and health promotion.

6. Future research:

- a) Research based on keywords: While antioxidants and anti-inflammatory effects dominate current literature, future research should focus on epigenetics, microbiomes and nutrigenomics to capture evolving scientific information.
- b) Broaden database inclusion: This study is only limited to the SCOPUS database. Future bibliometric analyses should integrate other databases such as Web of Science and PubMed to ensure comprehensive coverage.
- c) Bridge basic and clinical research: Researchers should consider strengthening the link between in vitro and clinical applications particularly in the area like cardiovascular health, metabolomic syndrome and neurodegeneration.

Supplementary Materials: Not Applicable.

Data Availability: Data was available in the manuscript.

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