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Scientific trends in bioactive compounds in food: a bibliometric analysis focused on publications in 2015–2025

Murdiah[1*], Baiq Apriza Lia Fitri[1], Yossy Ayuliansari[1], Baiq Pebrianti Hidayati[1], Nurhayati[2]
[1]Food Technology, Faculty of Engineering, Institut Teknologi Lombok, Indonesia
[2]Agricultural Product Technology, Faculty of Agriculture, Universitas Muhmmadiyah Mataram, Indonesia
*corresponding author: murdiah@lit.ac.id

ABSTRACT

Due to their significant role in promoting health and preventing chronic diseases, bioactive compounds in food have become a central subject of research. This study presents a bibliometric analysis of research trends in bioactive food compounds from 2015 to 2025. Data were collected and processed using Publish or Perish and Excel from Google Scholar with the keywords "bioactive compounds in food." VOSviewer was then used to visualize the co-occurrence of keywords and citation networks. The bibliometric analysis of publications on bioactive compounds in food reflects the rising importance of food-derived bioactive compounds, with 340 articles generated. The high frequency of studies focusing on delivery systems, antioxidant activity, and compound stability highlights a strong emphasis on the practical applications and health benefits of bioactive compounds in food. Thematic clustering revealed various research focuses, such as marine-based ingredients, plant-derived phytochemicals, functional food formulation, and processing technologies. Overlay and density visualizations further indicate a shift over time from identifying and extracting compounds to studying their application, bioavailability, and health impact. The bibliometric patterns highlight the considerable potential of food bioactive compounds to become a primary research trajectory and a focal point for future investigations.

Keywords: antioxidant activity; functional food; nutraceutical; VOSviewer

INTRODUCTION

Bioactive compounds are naturally found in food. They indicate physiological effects beyond their basic nutritional value (Banwo et al., 2021) (Awulachew, 2024). A number of these bioactive compounds (polyphenols (Cosme et al., 2020), flavonoids (Panche et al., 2016), carotenoids (Maoka, 2020), and bioactive peptides (Sandate-Flores et al., 2022)) have been linked to a variety of health benefits, including antioxidant (Kurnia et al., 2024), anti-inflammatory, antimicrobial, and anticancer properties (Veneziani et al., 2017).

Over the past decade, scientific interest in bioactive compounds as functional food has expanded considerably. This has been achieved by increasing awareness of the role of diet in health maintenance and disease prevention (Teodoro, 2019) (Khairnar et al., 2023). Consequently, research on bioactive compounds has advanced from fundamental characterization to applied studies of food processing technologies, bioavailability enhancement, and product stability and formulation.

In this context, a bibliometric approach offers a systematic method for mapping scientific outputs and identifying trends in research topics (Donthu et al., 2021). The bibliometric analysis facilitates the quantitative calculation of publication trends (Wen et al., 2021), citation patterns, and collaboration networks, thereby offering a broader and more objective overview of the knowledge landscape (Ding et al., 2024).

The proliferation of publications, accompanied by their increasing heterogeneity, necessitates a systematic analysis to ascertain the most prevalent research outputs, identify the journals that function as primary publication platforms, and assess the evolution of this trend (Abrar & Verma, 2024). For instance, the identification of the prevalence of review versus original research articles can facilitate the estimation of the maturity of the research field (Fu et al., 2023). Furthermore, analysis of journal distribution data can facilitate the identification of the disciplines and editorial scopes that demonstrate the greatest receptiveness to publishing work related to bioactive food components.

The objective of this study is to address the aforementioned gap by conducting a comprehensive bibliometric analysis of scientific publications related to bioactive compounds in food from 2015 to 2025. The analysis encompasses the volume of annual publications, the categorization of publication types, and the distribution across scientific journals.

METHODOLOGY

This study employed a descriptive bibliometric approach to analyze the development of scientific publications (Kirby, 2023) related to bioactive compounds in food over the period 2015–2025. The data were collected using the Publish or Perish (PoP) Windows GUI Edition 8.17.4863.9118 application, which extracts bibliographic information from Google Scholar. The search strategy incorporated a combination of keywords, including "bioactive compounds in food," to ensure comprehensive coverage of the subject area. The search was conducted exclusively on English-language documents (the objective of the search process is to enhance the comprehensiveness, consistency, and international visibility of the literature samples), and the results were filtered to exclude duplicates and non-academic sources.

The bibliographic data (comprising titles, authors, years, publication types, and journal names) were exported in CSV format for further processing (Lazarides et al., 2023). Microsoft Excel was utilized to clean and organize the data, categorize the types of publications (articles, reviews, book chapters), and generate descriptive statistics and trend visualizations.

To explore thematic structures and research networks within the literature, VOSviewer version 1.6.20 software was utilized. This tool facilitated the construction of visual maps based on keyword co-occurrence, author collaboration, and

journal co-citation (Rani et al., 2022). The analysis focused on key bibliometric indicators, including annual publication trends, distribution by publication type, and the most prolific journals in the field.

RESULTS AND DISCUSSION

A total of 340 metadata articles were extracted from the Publish or Perish (PoP) application, including 273 research articles and 67 review articles (Table 1).

An examination of annual publication trends reveals a discernible upward trajectory over the past decade. As illustrated in Table 2, the number of publications in the early years was relatively low, with 27 in 2015 and 17 in 2016. However, a marked increase was observed in 2017, with the number of publications reaching 28. This upward trend persisted, culminating in a significant peak of 50 publications in 2020. This surge in interest is indicative of a growing scientific focus on the health-promoting properties of bioactive compounds.

Table 1.
The number of food bioactive compounds publications by type

No.	Type	Number of Publications
1	Article	273
2	Review	67

Table 2.
The number of food bioactive compounds publications in the last decade

No.	Year	Number of Publications
1	2015	27
2	2016	17
3	2017	28
4	2018	39
5	2019	39
6	2020	50
7	2021	36
8	2022	49
9	2023	41
10	2024	12
11	2025	2

Following 2020, the publication output remained high but exhibited some fluctuation, with 36 publications in 2021, 49 in 2022, and 41 in 2023, indicating sustained research engagement. A notable decline is evident in 2024 (12 publications) and 2025 (2

publications). However, this is likely attributable to indexing delays in bibliographic databases rather than a decline in research activity (Tonin et al., 2021) (Ortega et al., 2024).

The network visualization constructed by VOSviewer illustrates the semantic structure and thematic clusters within the research on food-derived bioactive compounds. Each node in the network corresponds to a frequently occurring keyword, while the size of each node reflects its frequency; the larger each node, the more frequently it appeared in the set of publications. The thickness of the links between nodes is indicative of the strength of their co-occurrence, suggesting a close thematic relationship and frequent joint appearance in the literature (Xie et al., 2021).

In order to comprehend the thematic structure within this expanding corpus of literature, eight keyword clusters were identified through co-occurrence analysis using VOS-Viewer. Each cluster consists of related terms that frequently appear together (Parlina et al., 2020), thereby highlighting the main thematic directions within the field (Saputra & Purnomo, 2023).

Cluster 1 centers on emerging sources and applications, encompassing bioactive metabolites, novel functional foods, nutraceuticals, prebiotics, and seaweed. This finding suggests an exploration of innovative bioactive ingredients, particularly those derived from marine sources.

Cluster 2 is characterized by an emphasis on fundamental nutritional and compositional aspects, incorporating terminology such as "carbohydrate," "nutritional value," "physicochemical characteristics," and "secondary metabolite."

Cluster 3 encompasses specific foodstuffs, including avocado, coffee, olive oil, and tea. This suggests the necessity for targeted research regarding the functional contributions and potential applications in food packaging of these commodities.

Cluster 4 is centered on essential oils, garlic, and Mediterranean herbs. This focus underscores the bioactive potential and therapeutic properties of medicinal and aromatic plants.

Cluster 5 encompasses anthocyanin, catechin, chlorophyll, and functional compounds, thereby signifying a pronounced interest in natural antioxidants and pigment compounds.

Cluster 6 is centered on the subject of lipid-based components and their relationship to gut health. Within this cluster, specific terms such as "oil," "lipid," "probiotic," and "important bioactive compounds" are utilized.

Cluster 7 integrates flavonoids, phenolics, and processing technology, signifying an emphasis on the extraction and preservation of plant-derived compounds through meticulous extraction and preservation methods.

Cluster 8 encompasses biological, chemical, and pharmaceutical

applications, thereby reflecting translational research interests that span the domains of food science and pharmaceutical innovation.

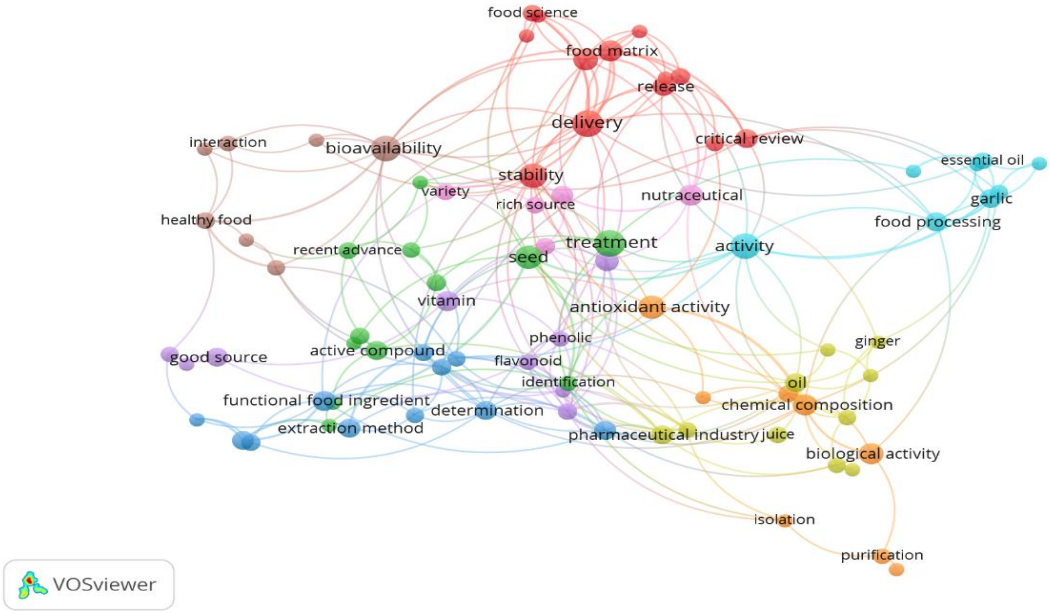

Figure 1. Network visualization of interconnections research topic

Figure 1 presents a visual representation of the co-occurrence network, offering a more comprehensive depiction of the structural interconnections among the key research themes. The utilization of color variations in cartographic representations is of paramount importance for the comprehension of thematic categorization and the discernment of interrelationships among phenomena (Yin, 2024). Each distinct color of the clusters signifies a particular aspect or subject that is frequently observed to occur in conjunction with others (Mamat et al., 2024). In this network, each node represents a frequently occurring keyword, with node size corresponding to term frequency (Zhao et al., 2019), and link thickness denoting the strength of co-occurrence. The clustering is color-coded, thereby exhibiting distinct thematic groupings (Meng et al., 2020).

A prominent red cluster revolves around the concept of delivery, which is strongly associated with terms like food matrix, release, stability, and food science. This finding indicates a significant research direction in the development and optimization of delivery systems for bioactive compounds in food products. The terms "nutraceutical" and "critical review" are proximate in meaning and signify the presence of both applied and evaluative research in this domain.

Conversely, a green cluster places emphasis on treatment, antioxidant activity, seeds, and vitamins, thereby underscoring research on the therapeutic potential of bioactive compounds. The use of terms such as flavonoids, phenolics, and active

compounds underscores the emphasis on phytochemicals and their biological effects. As indicated by the related nodes of bioavailability, healthy food, and interaction, there is a growing interest in understanding the absorption and systemic behavior of these compounds.

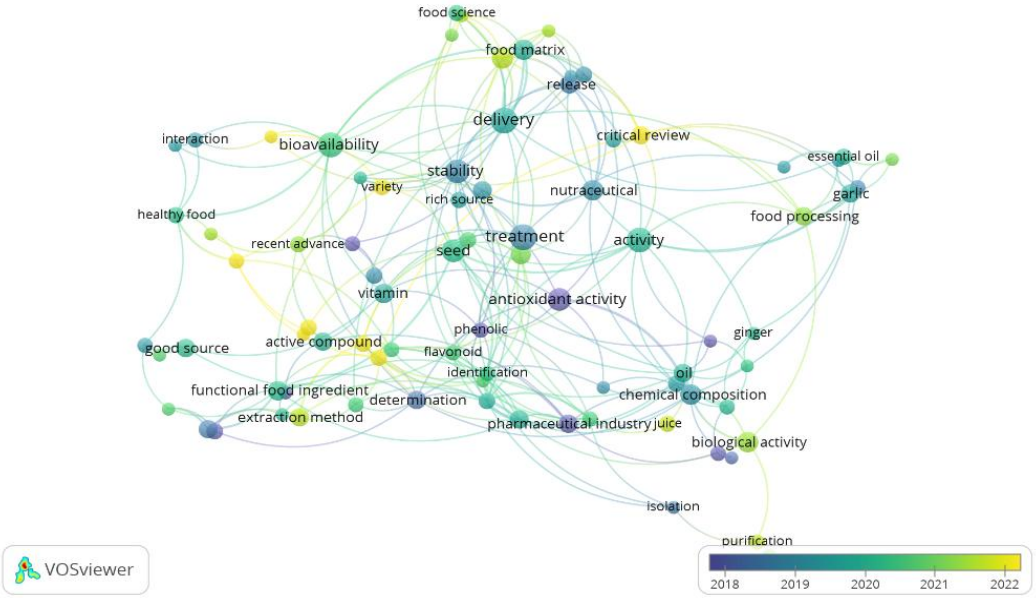

Figure 2. Overlay visualization of interconnections research year

Furthermore, the blue cluster highlights extraction methods, functional food ingredients, and determination, indicating methodological advancements in the isolation and quantification of bioactive compounds. Meanwhile, the orange-yellow cluster emphasizes biological activity, chemical composition, and specific plant sources such as ginger, garlic, and juice, reflecting studies on their health impacts.

Figure 2 illustrates the temporal evolution of research through an overlay visualization that maps keywords based on their average publication year (Fitri et al., 2023). The magnitude of the node is directly proportional to its frequency of appearance and its centrality to the research domain under investigation (Dubey et al., 2023). This observation is particularly evident for keywords such as "food matrix," "delivery," "seed," and "treatment" nodes that are considerably large, indicating their key roles and high prevalence in the body of functional food research.

Furthermore, the color variation across nodes is indicative of the average publication year of each keyword (Saber & Hamed, 2023). The utilization of darker hues, such as purple and blue, signifies keywords that experienced heightened research interest in the early years of the study, specifically from 2018 to 2019. In contrast, the employment of lighter hues, including yellow, denotes keywords that have garnered increased study interest in more recent years, from 2021 to 2022. This color-coding underscores a gradual shift in research focus from fundamental aspects, such as

extraction and identification, toward more applied topics, including delivery, stability, and food matrix. Visualization thus not only reveals the historical progression of research trends but also underscores how the field has evolved in response to growing knowledge and application needs.

Additionally, the thickness and proximity of the lines between nodes are indicative of the strength of co-occurrences and thematic relationships (Saputro et al., 2023). The thickness and length of the links are indicative of a robust and proximate association, thereby suggesting that these keywords are frequently co-occurring in extant literature (Dubey et al., 2023). For instance, the analysis of clusters of delivery, food matrix, and treatment reveals a pronounced interconnectedness, indicative of a cohesive research trajectory centered on delivery mechanisms and the stability of functional compounds. A similar correlation has been observed between "antioxidant activity," "phenolic," and "flavonoid." This observation underscores the interconnected nature of these variables and emphasizes their collective significance in elucidating the health benefits and mechanisms of action associated with them.

Density visualization in figure 3 highlights the concentration and frequency of keyword appearances across the dataset (Fitri et al., 2023). Bright yellow zones around terms such as "treatment," "delivery," "stability," "activity," and "antioxidant activity" signify high research intensity. Moderately dense areas include terms such as "food matrix," "nutraceutical," and "vitamin," indicating continued but comparatively less saturated interest. Peripheral zones with darker blue hues (e.g., essential oil, purification, and isolation) point to specialized topics representing opportunities for future research development.

The bibliometric mapping reveals that the field of bioactive compounds in functional foods is characterized by diverse thematic clusters and sustained scientific interest. The observed trends suggest several promising directions for future research. First, there is a need for more in-depth studies on the bioavailability and metabolic pathways of specific bioactive compounds, particularly those derived from underutilized food sources such as seaweed, avocado, and Mediterranean herbs. Additionally, further investigation into the synergistic effects of multiple bioactive compounds within complex food matrices could provide valuable insights into optimizing functional food formulations.

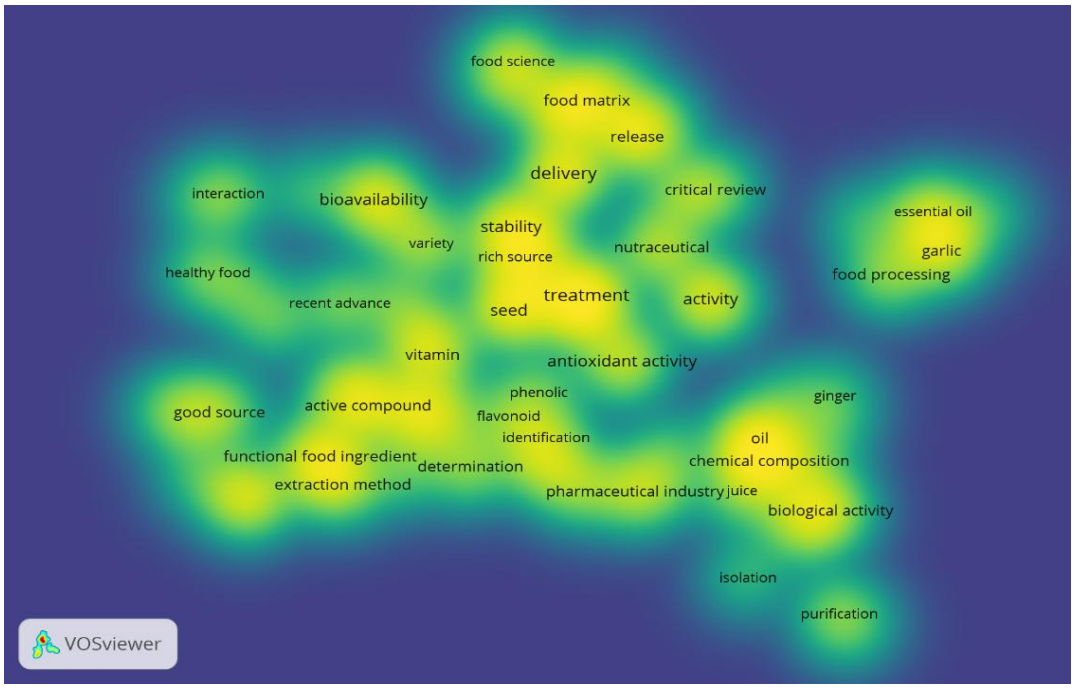

Figure 3. Overlay visualization of interconnections research year

This perspective offers a comprehensive overview of the intellectual framework and historical development of the field. This paradigm shift highlights a notable transition in research focus, progressing from fundamental investigations of compounds and their properties toward more applied perspectives, such as delivery mechanisms and processing methods.

This potential gap in existing knowledge as well as opportunities for future research, particularly with respect to integrating delivery technologies and food processing techniques to maximize health benefits derived from functional food components.

CONCLUSION

A bibliometric analysis of publications on bioactive compounds in foods from 2015 to 2025 yielded 340 articles, reflecting a consistent and increasing level of research interest, as evidenced by a substantial growth in both original research and review articles. The preponderance of studies centered on delivery systems, antioxidant activity, and compound stability highlights a pronounced emphasis on the practical application and health functionality of bioactive compounds in foods. Thematic clustering underscores a variety of research foci, encompassing marine-based ingredients, plant-derived phytochemicals, functional food formulation, and processing technologies. Furthermore, overlay and density visualizations suggest a shift in focus from the identification and extraction of compounds to the analysis of applications, bioavailability, and health impact studies.

In light of these findings, future research endeavors should prioritize the exploration of underutilized food sources, the enhancement of compound delivery and stability, and the investigation of synergistic effects within food systems.

REFERENCES

Abrar, K. M., & Verma, A. (2024). Bibliometric Analysis of Research Trends in Organic Foods : A Retrospective Scientometric Overview (2014-2023). 6798, 10306–10327.

Awulachew, M. T. (2024). Functional Foods: Functional Ingredients, Sources and Classification, Health Claims, Food Intolerance, and Allergy. https://doi.org/10.5772/intechopen.114157

Banwo, K., Olufunke, A., Adesulu-dahunsi, A. T., Kumar, D., Thakur, M., Tripathy, S., Singh, S., Patel, A. R., Kumar, A., Noe, C., & Lara, G. (2021). Food Bioscience Functional importance of bioactive compounds of foods with Potential Health Benefits : A review on recent trends. Food Bioscience, 43(July), 101320. https://doi.org/10.1016/j.fbio.2021.101320

Cosme, P., Rodríguez, A. B., Espino, J., & Garrido, M. (2020). Plant phenolics: Bioavailability as a key determinant of their potential health-promoting applications. Antioxidants, 9(12), 1–20. https://doi.org/10.3390/antiox9121263

Ding, Y., Elisa, A., Poubel, P., & Vu, T. Q. (2024). Food Design in China - A visual analysis based on VOSviewer. 104–110. https://doi.org/10.1201/9781003386858-15

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Marc, W. (2021). How to conduct a bibliometric analysis : An overview and guidelines. Journal of Business Research, 133(March), 285–296. https://doi.org/10.1016/j.jbusres.2021.04.070

Dubey, P., Dubey, P., Agrawal, P. K., Chourasia, H., Nayak, M., & Gehani, H. (2023). Bibliometric Analysis of Data Science Research: A Decade of Insights from Web of Science. https://doi.org/10.1109/icstcee60504.2023.10585030

Dubey, P., Dubey, P., Agrawal, P. K., Chourasia, H., Nayak, M., & Gehani, H. (2023). Bibliometric Analysis of Data Science Research: A Decade of Insights from Web of Science. https://doi.org/10.1109/icstcee60504.2023.10585030

Fitri, M. M., Iswandi U, Syah, N., & Yuniarti, E. (2023). Bibliometric Analysis of Spatial Stunting Using VOSviewer. Jurnal Penelitian Pendidikan IPA, 9(12), 1298–1305. https://doi.org/10.29303/jppipa.v9i12.5914

Fu, Y., Mao, Y., Jiang, S., Luo, S., Chen, X., & Xiao, W. (2023). A bibliometric analysis of systematic reviews and meta-analyses in ophthalmology. Frontiers in Medicine, 10. https://doi.org/10.3389/fmed.2023.1135592

Khairnar, S. J., Rudrapal, M., Ahire, E. D., Jagtap, M. R., & Kshirsagar, S. J. (2023). Overview of Functional Foods (pp. 1–31). Apple Academic Press.

https://doi.org/10.1201/9781003395737-1

Kirby, A. (2023). Exploratory Bibliometrics: Using VOSviewer as a Preliminary Research Tool. Publications, 11(1). https://doi.org/10.3390/publications11010010

Kurnia, D. A. R., & Dwi, R. K. (2024). Kajian pustaka aktivitas tanaman kepuh (Sterculiafoetida L .) sebagai antioksidan alami Literature review on the activity of kepuh plant (Sterculiafoetida L .) as a natural antioxidant. 4(1).

Lazarides, M. K., Lazaridou, I., & Papanas, N. (2023). Bibliometric Analysis: Bridging Informatics With Science. The International Journal of Lower Extremity Wounds. https://doi.org/10.1177/15347346231153538

Mamat, M., Wang, L., Jin, L., He, K., Li, L., & Chen, Y. (2024). Beyond nodes and edges: a bibliometric analysis on graph theory and neuroimaging modalities. Frontiers in Neuroscience. https://doi.org/10.3389/fnins.2024.1373264

Maoka, T. (2020). Carotenoids as natural functional pigments. Journal of Natural Medicines, 74(1). https://doi.org/10.1007/s11418-019-01364-x

Meng, L., Wen, K. H., Brewin, R., & Wu, Q. (2020). Knowledge atlas on the relationship between urban street space and residents' health-a bibliometric analysis based on vos viewer and cite space. Sustainability (Switzerland), 12(6). https://doi.org/10.3390/su12062384

Ortega, J. L., & Delgado-Quirós, L. (2024). The indexation of retracted literature in seven principal scholarly databases: a coverage comparison of dimensions, OpenAlex, PubMed, Scilit, Scopus, The Lens and Web of Science. Scientometrics. https://doi.org/10.1007/s11192-024-05034-y

Panche, A. N., Diwan, A. D., & Chandra, S. R. (2016). Flavonoids: An overview. Journal of Nutritional Science, 5. https://doi.org/10.1017/jns.2016.41

Parlina, A., Ramli, K., & Murfi, H. (2020). Theme Mapping and Bibliometrics Analysis of One Decade of Big Data Research in the Scopus Database. Information-an International Interdisciplinary Journal, 11(2), 69. https://doi.org/10.3390/INFO11020069

Saber, A. A., & Hamid, N. K. (2023). Complex networks analysis: centrality measures. Indonesian Journal of Electrical Engineering and Computer Science, 29(3), 1642. https://doi.org/10.11591/ijeecs.v29.i3.pp1642-1647

Rani, N., Bhardwaj, A. K., Das, P., & Sharma, A. (2022). Bibliometric analysis of rumor detection via web of science from 1989 to 2021. Concurrency and Computation: Practice and Experience, 34(25). https://doi.org/10.1002/cpe.7260

Sandate-Flores, L., Méndez-Zamora, G., Morales-Celaya, M. F., Lara-Reyes, J. A., Aguirre-Arzola, V. E., Gutiérrez-Diez, A., Torres-Castillo, J. A., & Sinagawa-García, S. R. (2022). Biofunctional properties of the

bioactive peptide from protein isolates of jiotilla (Escontria chiotilla) and pitaya (Stenocereus pruinosus) seeds. Food Science and Technology (Brazil), 42, 1–7. https://doi.org/10.1590/fst.57922

Saputra, C. S., & Purnomo, A. R. (2020–2021). Analisis Bibliometrik dari Ketrampilan Proses Sains dan Experiential Learning pada Tahun 2020-2021. Jurnal Pendidikan Sains, 7(1), 13–21. https://doi.org/10.26740/jppms.v7n1.p13-21

Saputro, D. R. S., Prasetyo, H., Wibowo, A., & Khairina, F. (2023). Bibliometric analysis of neural basis expansion analysis for interpretable time series (n-beats) for research trend mapping. Barekeng, 17(2), 1103–1112. https://doi.org/10.30598/barekengvol17iss2pp1103-1112

Teodoro, A. J. (2019). Bioactive compounds of food: their role in the prevention and treatment of diseases. Oxidative medicine and cellular longevity, 2019, 3765986.

Tonin, F. S., Araujo, A. G. S., Fachi, M. M., Ferreira, V. L., Pontarolo, R., & Fernandez-Llimos, F. (2021). Lag times in the publication of network meta-analyses: a survey. BMJ Open, 11(9). https://doi.org/10.1136/BMJOPEN-2020-048581

Veneziani, G., Novelli, E., Esposto, S., Taticchi, A., & Servili, M. (2017). Chapter 11 - Applications of recovered bioactive compounds in food products. In Olive Mill Waste. Elsevier Inc. https://doi.org/10.1016/B978-0-12-805314-0/00011-X

Wen, Q. J., Ren, Z. J., Lu, H., & Wu, J. F. (2021). The progress and trend of BIM research: A bibliometrics-based visualization analysis. Automation in Construction, 124, 103558.

Xie, H., Wen, Y., Choi, Y., & Zhang, X. (2021). Global trends on food security research: A bibliometric analysis. Land, 10(2), 119.

Yin, J. (2024). Bibliometric analysis of researches on the . 36(2), 184–190. https://doi.org/10.16250/j.32.1374.2023168

Zhao, L., Tang, Z. Y., & Zou, X. (2019). Mapping the knowledge domain of smart-city research: A bibliometric and scientometric analysis. Sustainability (Switzerland), 11(23), 1–28. https://doi.org/10.3390/su11236648

