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Navigating Global Research Trends on Seafoods-Related Foodborne Diseases: A Decadal Bibliometric Analysis

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ABSTRACT

Ensuring seafood safety has become a critical area of focus due to its strong association with foodborne diseases. Despite the critical nature of this field, an in-depth understanding of global research trends in this field remains limited. Our study conducted an extensive bibliometric analysis to track the evolution and thematic focus of research on seafood safety from 2013 to 2023. Utilizing Scopus for publication and citation data, along with VOSviewer for visualizing keyword networks, this study highlights key developments and scholarly efforts aimed at mitigating risks associated with seafoods consumption. The analysis pinpoints the United States, China, the United Kingdom, France, South Korea and Malaysia as leading contributors. Their extensive research outputs and collaborations have markedly shaped the field's evolution. The overall positive trajectory in research volume experienced a minor setback in 2022, suggesting a complex and dynamic research landscape. "Food Control" is identified as a principal journal for the dissemination of research works, anchoring a dynamic co-citation network that fosters extensive international dialogue. We categorize seven principal research clusters: epidemiology, molecular detections, microbial resistance, bacteriophage applications, toxin detection methodologies, predictive modelling and biofilm studies. These clusters encompass the scopes and the breadth of current investigations. This decade-long review highlights the necessity for cohesive global research strategies to enhance the knowledge and control of foodborne pathogens in seafoods. This strategy is critical for improving food safety measures and safeguarding public health globally.

Keywords:
Antimicrobial resistance; Bibliometric analysis; Foodborne diseases; Global research trends; Seafood safety

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1. Introduction

In the swiftly advancing realm of food safety, the worldwide burden of foodborne illnesses associated with seafoods consumption presents a multi-faceted challenge that spans public health, trade and environmental sustainability [1,2]. Seafoods are nutritious food choices, providing high-quality proteins, essential omega-3 fatty acids, vitamins and minerals [3]. Nevertheless, the rising worldwide demand for seafoods and the expansion of international trade have sparked worries about the spread of foodborne illnesses through aquatic food products [4]. This study presents a comprehensive bibliometric analysis to clarify global research trends in the occurrence, prevention and management of foodborne illnesses lined to seafoods consumption.

The importance of undertaking foodborne illnesses related to seafoods is crucial because the economic impacts of this sector worth billions globally. The World Health Organization (WHO) identifies foodborne diseases as a leading cause for global morbidity and mortality. Key seafoods hazards such as *Vibrio* spp., *Salmonella*, Norovirus and Hepatitis A [5]. These pathogens can contaminate seafoods in several ways, such as environmental contamination, improper handling and inadequate cooking or processing [6]. The microbiological stability and public health safety of foods are predominantly determined by the ability of pathogenic microorganisms and fungi to survive within the food [7].

A bibliometric perspective provides valuable insights to examine the landscape of research and policy efforts to reduce the risks of seafoods consumption. Our study analyses publication trends, collaboration networks and co-citation networks to understand the evolution scientific advancements and public health initiatives in response to emerging challenges [8,9]. This approach helps to identify the most influential studies and authors, while also highlighting geographical and institutional contributions to the field, indicating a global overview of efforts to improve seafood safety [10].

The reason for conducting a bibliometric analysis is influenced by the ever-changing nature of foodborne pathogens and the ongoing emergence of new risks due to environmental changes, aquaculture practices and shifts in human consumption patterns [11]. Climate change, in particular, presents a considerable challenge as it impacts the spread and frequency of marine pathogens, highlighting the need for proactive and adaptive research approaches [12]. Additionally, the growing dependence on aquaculture to satisfy seafoods needs introduces new factors to consider, such as the use of antibiotics and the threat of antimicrobial resistance (AMR) [13].

The purpose of this study is to connect empirical research results with policy-making by offering a data-based summary of the research status on foodborne illnesses related to seafoods. It aims to pinpoint deficiencies in the current knowledge, upcoming research trends and areas necessitating further exploration. This bibliometric analysis is intended to promote a unified comprehension of worldwide research priorities and support the development of focused, evidence-backed approaches to reduce the public health hazards linked to seafoods consumption.

This study provides a wider discussion about food safety and public health, providing stakeholders such as researchers, policymakers, industry professionals and consumer advocacy groups with a thorough understanding of the obstacles and potential advancements in seafood safety [14]. By mapping the contours of research development and trends, we endeavour to support the development of integrated, science-based approaches to managing foodborne illnesses in the seafoods sector, thereby enhancing food security, protecting public health and supporting the sustainable growth of this vital global industry [3]. At the moment, there is still a lack of studies dealing with foodborne pathogens associated with seafoods compared to other meat products. The significant of this study is to understand the trends of global research efforts on seafood safety in

order to control foodborne pathogens in seafood. Developing these strategies is crucial for improving food safety and protecting public health around the world [15]. Hence, the study aimed to:

i. Evaluate the quality and productivity of current research on foodborne diseases in seafoods
ii. Examine the literature's impact, research networks and potential gaps.

2. Literature Review

The escalating issues of AMR among seafoods pathogens pose a grave threat to public health and food safety. Research conducted by Chen *et al.,* [16] bring to light the increasing prevalence of AMR, particularly in *Vibrio* spp. and *Enterococcus* spp., found in retail shrimp, alongside exploring the potential of flavonoids and novel bacteriophages for biocontrol. These studies collectively shed light on the complex ways that AMR spreads through aquaculture systems, emphasizing the critical need for new strategies to address this growing threat.

Palamae *et al.,* [17], Yu *et al.,* [18] and Fehrenbach *et al*., [19] have conducted research into alternative antimicrobial strategies targeting *Vibrio parahaemolyticus*. Their studies have shown the effectiveness of chitooligosaccharide-catechin conjugates, the importance of fish surface characteristics in biofilm formation and the potential of pulsed ultraviolet (PUV) light as a disinfection technique. These findings highlight the importance for a better understanding on how bacterial pathogens interact with their environments. They also emphasize the need to discover new antimicrobial compounds and methods, which are essential for creating effective defences against pathogens found in seafoods.

Ahmad *et al.,* [20] conducted a study on the potential of stingless bee products to inhibit microbial growth and prevent food spoilage, which is important for seafood safety and shelf life. In a separate study, Hasali *et al.,* [21] researched how certain bacteria from stingless bee honey could combat other pathogenic bacteria, suggesting the potential use of these beneficial bacteria as a natural preservative to maintain seafoods freshness and protect it against pathogenic microbes. In 2021, Mahmood *et al.,* [22] discovered that the beneficial properties of honey can change with the seasons, but they consistently show antimicrobial effects. This suggests that honey could serve as a natural way to preserve seafoods, possibly reducing the risk of foodborne illnesses.

Lee *et al.,* [23], Marquis *et al.,* [24] and Ma *et al.,* [25] have focused their research on various aspects of seafood safety, including studying the AMR and virulence factors of *Aeromonas* spp. found in ready-to-eat (RTE) seafoods, the microbiological safety of different raw seafoods dishes and the use of ultrasound processing to deactivate *Vibrio parahaemolyticus* in oysters. The increasing problems of multidrug-resistant pathogens in water and food supply chains, combined with increased consumer interest in raw seafoods products, highlights the critical need for continuous surveillance and the development of new preservation methods to ensure the safety of our foods.

Guedes *et al.,* [26], Frith *et al.,* [27] and Su *et al.,* [28] have conducted research on diverse aspects of seafood safety, including the microbiological quality of Pacific oysters, the effects of environmental factors on histamine-producing bacteria in the Gulf of Mexico and the development of a sensitive detection method for *Vibrio parahaemolyticus* using nanoparticles and aptamers. Their findings emphasize the critical need for thorough monitoring and the development of innovative preservation techniques to ensure food safety and public health.

In general, research related to bacteria is very crucial because it can provide more information that can be applied to solve problems facing by the industry [29,30]. Continued research and innovation to develop safer and more efficient approaches to manage and control foodborne

pathogens become the top priority by government. The emergence of multidrug-resistant organisms and the persistent need for raw seafoods underline the importance of regular monitoring. Additionally, there is a need to create new antimicrobial agents and methods to guarantee the safety and quality of seafoods products.

3. Methodology

Bibliometrics involves the collection, organization and analysis of bibliographic data from scientific publications [8,9,31,32]. It includes basic descriptive statistics, such as publishing journals, publication year and main author classification [33], as well as advanced techniques such as document co-citation analysis. The criteria for selecting documents for bibliometric analysis is summarized in Figure 1.

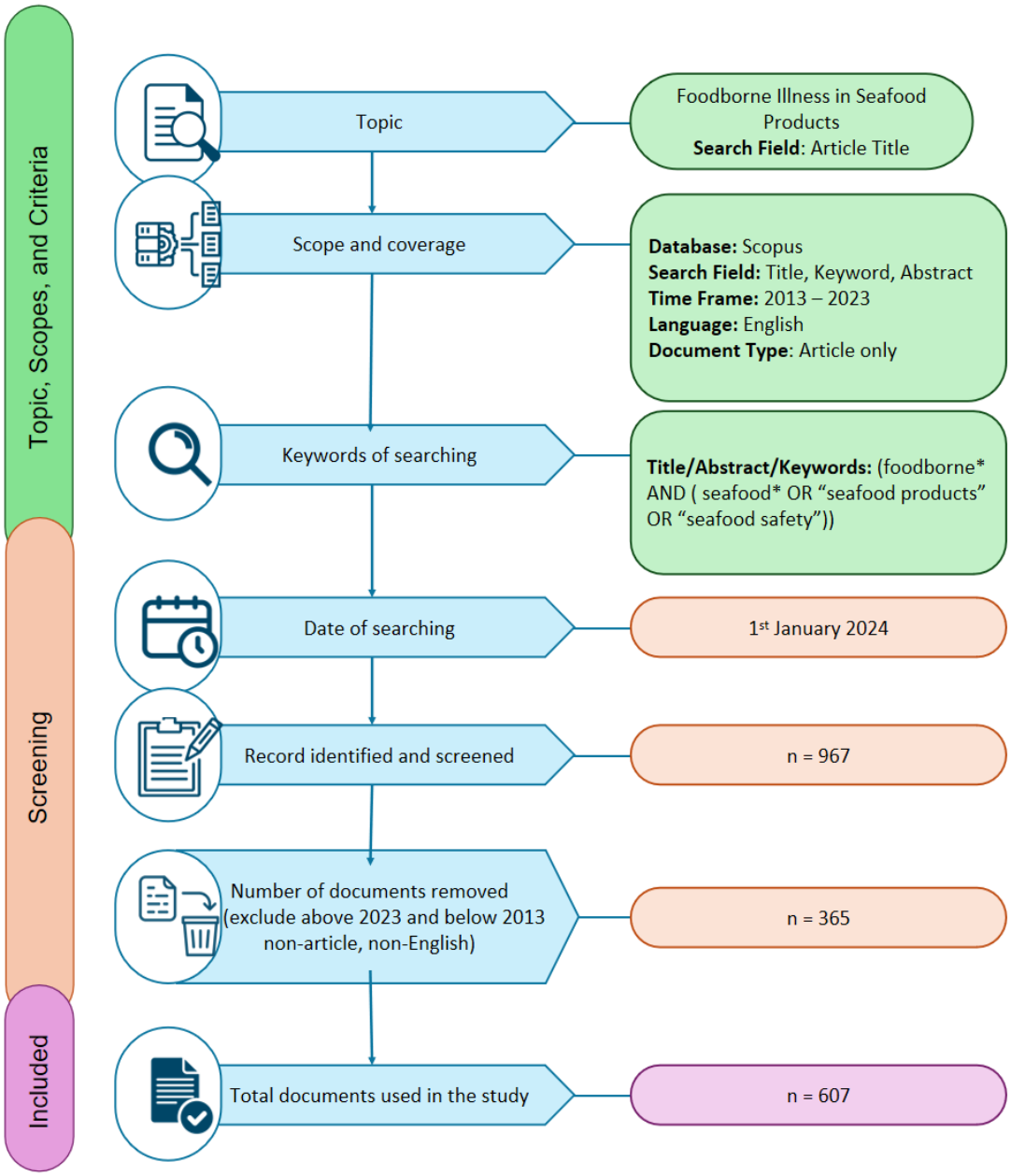

Fig. 1. Criteria for selecting documents for bibliometric analysis

A successful literature review involves an iterative process that includes identifying appropriate keywords, conducting a literature search and analysing thoroughly to create a comprehensive bibliography and obtain reliable results [34]. In line with this, the study aimed to focus on high-quality publications, which offer valuable insights into the theoretical perspectives shaping the research area. To ensure data reliability, the study utilized the SCOPUS database for data collection [31-35]. Furthermore, to guarantee the inclusion of high-quality publications, only articles published in rigorously peer-reviewed academic journals were considered, deliberately excluding books and lecture notes [36-38]. Notably, Elsevier's Scopus, known for its extensive coverage, facilitated the collection of publications spanning from 2013 to 2023 for subsequent analysis as shown in Figure 1.

Bibliometrics is a comprehensive method for collecting, managing and analysing bibliographic data from scientific literature [39]. It goes beyond basic descriptive statistics such as journal publications, publication year and leading author classifications [40]. It involves utilizing advanced methodologies like document co-citation analysis. Effective literature review, bibliography construction and reliable results require an iterative process involving suitable keywords, literature search and analysis [41]. The next section involves adopting search terms, screening initial search results and refining search results. Moreover, to ensure the inclusion of high-quality publications, only articles published in rigorously peer-reviewed academic journals were considered, while chapters of books and conference proceedings were excluded [42]. Scopus contains a vast number of journals, although its impact is limited to recent articles [42]. It allows scholars and researchers to discover trends, patterns and networks within scientific research, thereby aiding a deeper comprehension of the development of knowledge in different fields.

The research utilized a step-by-step approach to identify the keywords for searching articles. It began by searching the Scopus database using search string given in Table 1, thereby assembling 607 articles. Subsequently, the search query was adjusted to focus on the food safety concerns by emphasizing terms, like "foodborne*" AND "seafoods* OR seafoods products OR seafood safety".

Table 1
The search string

Scopus	TITLE-ABS-KEY (foodborne* AND (seafoods* OR "seafoods products" OR "seafood safety")) AND PUBYEAR > 2013 AND PUBYEAR < 2023 AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "re")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (PUBSTAGE, "final"))

This refinement process produced 967 results, which were further filtered to include only research articles in English, while excluding conference papers and book chapters as shown in Table 2. The final refined search string comprised 607 articles that were analysed for bibliometric analysis. By January 1 2024, all Scopus database articles related to seafoods related illnesses were examined in this study.

Table 2
The selection criterion is searching

Criterion	Inclusion	Exclusion
Language	English	Non-English
Timeline	2013 – 2023	< 2012, >2023
Literature type	Journal (Article)	Conference, Book chapter
Publication Stage	Final	In Press

We gathered datasets from the Scopus database that included details, like the publication year, title, author name, journal, citation and keywords in PlainText format, for the period spanning 2013

to December 2023. These datasets were then examined using VOSviewer software version 1.6.19 for analysing and creating maps through the application of VOS clustering and mapping techniques.

VOSviewer is an alternative to the Multidimensional Scaling (MDS) approach [43]. It shares similarities, with the MDS method in its objective, which is centred on arranging items in spaces so that the connection and likeness, between any two items are accurately represented by the distance separating them [44]. VOS, unlike MDS emphasizes calculating similarity metrics like Jaccard indexes and cosine. Instead VOS utilizes a method, for standardizing co-occurrence frequencies [45].

The VOSviewer software uses a method to conduct analyses focusing on creating visual representations of intricate data sets in a two dimensional bibliometric space [46]. To begin a similarity matrix is formed by normalizing the co matrix and using association strength as the measure, for determining similarity, between items [47]. The calculation of similarity (S*ij*) follows a formula:

$$S_{ij} = \frac{c_{ij}}{w_i \quad w_j}, \tag{1}$$

where C_{ij} signifies the number of times of co-occurrences and W_i and W_j represent the individual occurrences of the respective items *i* and *j* [48]. Next, this matrix undergoes the VOS mapping technique, which aiming to reduce the distance, between all pairs of items by finding a low dimensional depiction. This optimisation is encapsulated by:

$$\min V(x_1, \ldots, x_n) = \sum_{i<j} S_{ij} \ \|x_i - x_j\|^2, subject\ to\ \frac{2}{n(n-1)} \sum_{i<j} \|x_i - x_j\| = 1. \tag{2}$$

In the realm of VOSviewer's analytical framework, $X_i=(X_{i1},X_{i2})$ represents the position coordinates of each item on a two-dimensional map, where ‖·‖ signifies the Euclidean norm [34]. The variable n denotes the count of items to be positioned on the map. This detail procedure enables VOSviewer to display the bibliometric network showing how authors, articles and keywords are interconnected. The intensity of these connections is measured using an association strength metric providing insights, into collaborative dynamics and thematic focuses in research. This explained description outlines how VOSviewer methodically visualizes research trends revealing relationships and key patterns within scholarly data.

4. Results and Finding

The findings and related discussions on this study are presented based on the Research Question or (RQ 1), (RQ 2), (RQ3), (RQ4), (RQ5), (RQ6) and (RQ7) as follows:

4.1 RQ1: What are the Research Trends According to the Year of Publication?

The research trends according to the year of publication is one of the most important descriptive analyses for bibliometric study. This kind of analysis can reveal how research focus, methods and key themes shift over time, spotlighting the way topics and priorities evolve year by year. Furthermore, changes in the amount of research being published can signal shifts in what the academic community is interested in or what it's receiving funding for, while new emerging themes highlight fresh areas that are starting to draw attention. External factors like technological advances or global events also significantly influence the direction research takes. Overall, this analysis provides a roadmap of where academic inquiry is heading, helping to spot current knowledge gaps and forecast future trends.

Figure 2 shows that the trend of documents production based on the year collected through the Scopus Analyzer is as follows:

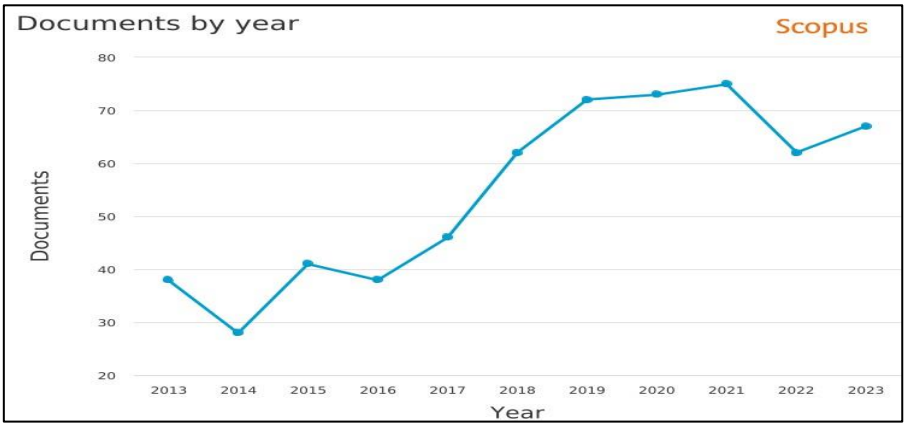

Fig. 2. Trend of documents by year

The Scopus-derived line graph presents the annual publication trends from 2013 to 2023, showing varying research output across the years. From 2013 to 2014, there is a noticeable decrease in publications, potentially due to factors like funding cuts or shifting research priorities. Between 2014 and 2017, a steady increase in publications suggests a resurgence of interest or additional resources in the field.

A slight decrease, in 2018 could indicate varying levels of research activity or a temporary shift in priorities. This is followed by a significant increase peaking in 2020. Such a rise typically signifies a growing interest in research possibly driven by discoveries or responding to needs. Beyond 2020 the number of publications stabilizes with a decline in 2022 suggesting a field with consistent publication patterns and normal fluctuations from year to year. The downward trajectory in 2023 may be attributed to factors impacting research output although it's worth noting that this data may not capture the full extent of publications, for the year given its ongoing nature.

The graph shows how publishing changes, over time affected by factors like economic trends, policy adjustments and global happenings. Lately there has been a shift in research focus on illnesses related to seafoods. Important research studies like the one by Fleming *et al.,* [49] explored the aspects of seafoods poisoning offering insights into trends, in research emphasis. Similarly, the work by Sioen *et al.,* [50] offers a comparative analysis of the nutritional versus toxicological implications of seafoods consumption globally, which may indirectly highlight shifts in research priorities over time. Furthermore, Page [51] explored into collaborative research efforts on seafoods toxins could provide valuable insights into the foundational directions of this field, offering a backdrop against which recent advances can be measured

4.2 RQ2: What is the Trend of Article Earnings Based on the Subject Area?

The research question explores how revenue generated from scholarly articles varies across different academic disciplines. Additionally, it looks at the impact of different publishing models, like open access versus subscription-based, on earnings in different disciplines. This insight helps publishers, academic institutions and researchers strategize their publication and funding approaches effectively. Figure 3 shows the breakdown of the distribution of studies based on foodborne poisoning seafoods products performed based on related subjects:

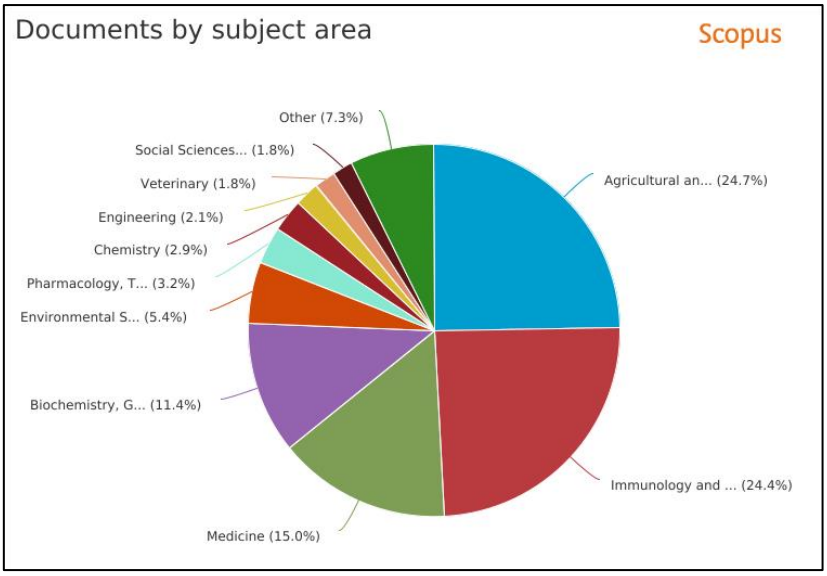

Fig. 3. Document by subject area

The pie chart (Figure 3) from our bibliometric analysis, sourced from Scopus, illustrates how research on foodborne diseases in seafoods is spread across various academic disciplines, highlighting the subject's multi-disciplinary interest and its broad research impact.

The analysis shows that Agricultural and Biological Sciences lead with 24.7% of the publications, emphasizing the study of foodborne pathogens and their impact on agriculture. Close behind, Immunology and Microbiology make up 24.4% of the research, focusing on microbial pathogenesis and immune responses critical for food safety.

Medicine accounts for 15% of the publications, with a focus on public health implications, diagnostics and epidemiology of foodborne illnesses. Contributions from Biochemistry, Genetics and Molecular Biology (11.4%) underscore the molecular-level understanding of pathogens, crucial for developing advanced detection and control strategies.

Environmental Science, which accounts for 5.4% of the research, examines how environmental factors contribute to the spread of pathogens and the safety of seafoods. Research in other disciplines, such as Pharmacology, Toxicology and Pharmaceutics (3.2%), Chemistry (2.9%), Engineering (2.1%), Veterinary (1.8%) and Social Sciences (1.8%) expands the discussion to cover topics such as treatment methods, contaminant testing, food processing safety, animal welfare and the socioeconomic impacts. The 'Other' category, comprising 7.3% encompasses fields like law and public policy, which are crucial in addressing the complexities of foodborne pathogens.

In this study, a wide range of disciplines came together to address the problem of diseases in seafoods showing an effort to protect public health and ensure food safety. The research looked into aspects of illnesses in seafoods with inputs from fields such, as environmental science, public health, nutrition, toxicology and food science.

This multi-disciplinary approach plays a role in tackling the challenges involved in ensuring the safety of seafoods products. In a study focusing on designing health based research for chemical contamination in fish, Pollock *et al.*, [52] discussed the collaboration between environmental science and public health to evaluate risks and create strategies for mitigation. Their work emphasizes the importance of integrating fields to gain an understanding of foodborne illnesses related to seafoods.

Sioen *et al.,* [53] conducted an analysis that examines the toxicological aspects of seafoods consumption in various regions. Their research highlights the importance of science and toxicology in foodborne pathogens and their impact on public health. Hall [54] delves into the relationship between food science and toxicology underscoring the efforts needed to enhance food safety. This

viewpoint is crucial for developing approaches to detect and understand the behaviour of pathogens present in seafoods.

4.3 RQ3: What is the Title of the Article that has the Highest Number of Citations by Ranking?

The bibliometric data presented in Table 3 highlights influential research on foodborne diseases in seafoods, highlighting key areas of scientific areas of focus. This research, which received significant citations from 2013-2023, has played a crucial role in advancing our understanding of food safety and public health.

A 2018 article from "Food Chemistry" on seafoods preservation via edible films and coatings leads with 366 citations, reflecting the pressing need for innovative preservation methods that ensure safety and extend shelf life [55]. Next, articles from "Food Microbiology" on antibiotic resistance in *Vibrio* species [56] has received 280 citation and article from “Applied and Environmental Microbiology” on the epidemiology of *Salmonella* has garnered 247 citations [57]. These works emphasise the global public health challenge posed by these pathogens and the necessity for ongoing research into effective microbial control [55-57].

Table 3
Top 10 number of citations

Title	Year	Name of Journal	Volume	Cited by	References
Edible films and coatings in seafoods preservation: A review	2018	Food Chemistry	240	366	[55]
Antibiotic resistance of *Vibrio parahaemolyticus* and *Vibrio vulnificus* in various countries: A review	2016	Food Microbiology	57	280	[56]
Worldwide epidemiology of *Salmonella* serovars in animal-based foods: A meta-analysis	2013	Journal of Food Protection	76	247	[57]
Economically motivated adulteration (EMA) of food: Common characteristics of EMA incidents	2019	Applied and Environmental Microbiology	85	242	[58]
Prevalence and antimicrobial susceptibility of *Vibrio parahaemolyticus* isolated from retail shrimps in Malaysia	2015	Frontiers in Microbiology	6	203	[59]
Recent Advances in Food Processing Using High Hydrostatic Pressure Technology	2016	Critical Reviews in Food Science and Nutrition	56	168	[60]
Microbial decontamination of food by electron beam irradiation	2015	Trends in Food Science and Technology	44	150	[61]
Natural products with preservative properties for enhancing the microbiological safety and extending the shelf-life of seafoods: A review	2020	Food Research International	127	142	[62]
Vibrio vulnificus: new insights into a deadly opportunistic pathogen	2018	Environmental Microbiology	20	141	[63]
Common source outbreaks of *Campylobacter* infection in the USA, 1997-2008	2013	Epidemiology and Infection	141	124	[64]

The issue of food fraud is discussed in an article, from the "Journal of Food Protection" with 242 citations emphasizing the health impacts of food adulteration and the need for detection and prevention methods [58]. Moreover, research from "Frontiers in Microbiology" focusing on shrimp in Malaysia [59] and advancements in high-pressure food processing technology as published in the Critical Reviews in Food Science and Nutrition [60] shed light on food safety concerns and the role of technology in upholding standards in a global market.

Explorations of alternative decontamination methods like electron beam irradiation [61] and natural preservatives [62] are highlighted through articles cited in "Trends in Food Science and Technology" and "Food Research International," demonstrating efforts to discover the environmentally sustainable and consumer-friendly solutions. Another important issue is the highlight of *Vibrio vulnificus* as new insights into a deadly opportunistic pathogen [63]. Lastly, a study on *Campylobacter* outbreaks in the USA published in "Epidemiology and Infection" cited 124 times emphasizes the importance of tracking outbreaks for public health interventions [64].

Collectively, these articles constitute a cornerstone of the scholarly dialogue on seafoods-related foodborne diseases, informing ongoing research, industrial protocols and policy-making to enhance food safety and protect consumers. The scope of the journals and the citation metrics affirm the significant influence of these studies across various scientific domains.

4.4 RQ4: What is the Map of Co-Authorship by Authors?

VOSviewer is a tool for creating bibliometric visualisations, specifically focusing on co-authorship networks within academic research. Since the details given are generic and pertain to the functionality and interpretation of such visualisations rather than specific research findings or data, direct citations to external sources or specific studies are not applicable [65].

Figure 4 appears to be a VOS viewer visualisation map of co-authorship based on bibliometric data. The visualisation highlights key elements of collaborative networks. Nodes symbolise authors, with their size indicating publication volume or network centrality. Larger nodes point to more prolific or central authors. Meanwhile, Edges (Lines) show co-authorship links, where thickness reflects the number of co-authored works—thicker lines mean more collaboration. Colour Coding differentiates authors and connections by factors like affiliation, the field of study, or collaboration timing, with colour gradients marking collaboration periods (e.g., 2018.8 to 2019.4). Together, these features provide a clear overview of the network, pinpointing major contributors and the nature of their collaborations.

Figure 4 describes the utilisation of a specialized map to delineate collaborative networks and interactions within a specified discipline or among a cohort of researchers throughout a certain timeframe. The metric "Total Link Strength" ostensibly quantifies the co-authorship dynamics among authors, derived from the volume of joint publications and may accord higher significance to more recurrent or recent collaborations.

Prominent co-authors are identified through maximal total link strength scores, signifying robust or extensive co-authorship ties. Notably, Chinnain, Mireille; Darius, Hélène Taiana and Hess, Philipp exhibited the paramount total link strength of 18, marking them as pivotal co-authors within the network, indicative of frequent and/or diverse collaborative engagements.

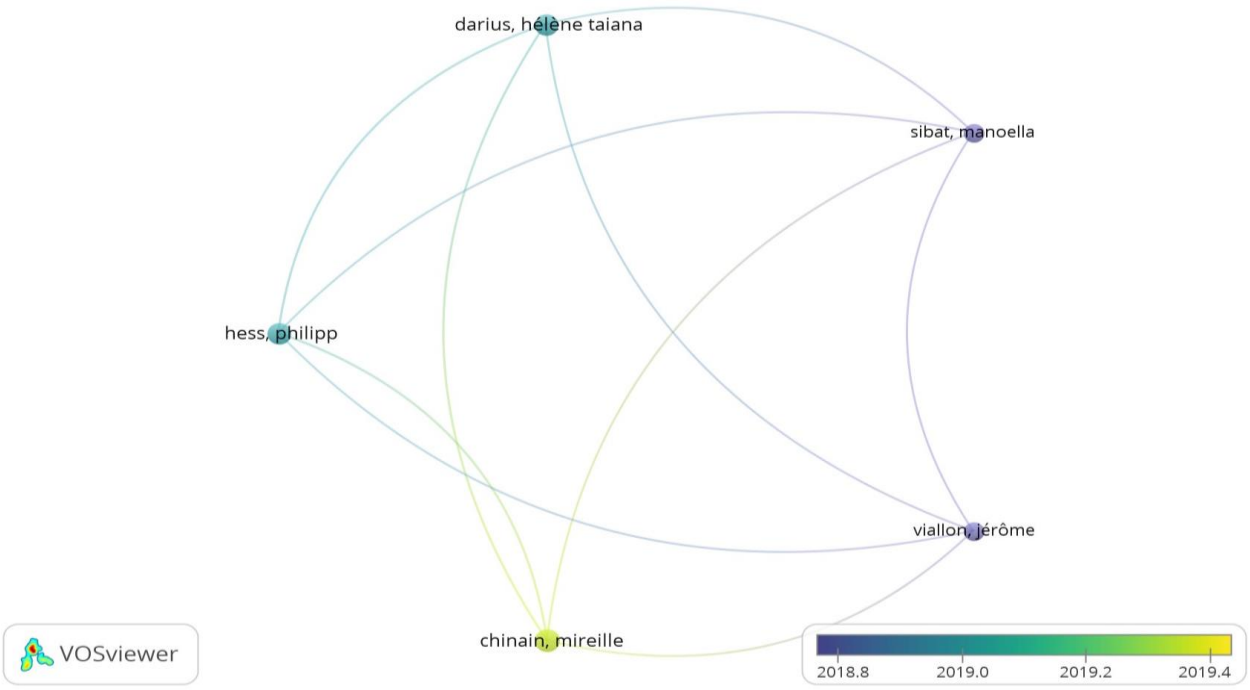

Fig. 4. Network visualization map of Co-Authorship

Table 4 lists the authors along with the number of documents they have published, the number of citations received and the total strength of their co-authorship links. The authors with the highest total link strength are at the top of the table, indicating their significant position in terms of collaboration within the group. Table 4 introduces a co-authorship map analysis to elucidate collaborative networks within a specific academic field or among a set of researchers over a defined period. It employs the "Total Link Strength" as a key metric to assess the dynamics of co-authorship among researchers, calculated from the number of joint publications. This measure may prioritise collaborations that are either more frequent or recent, thereby providing insights into the intensity and frequency of research partnerships.

Table 4
Verification of 30 authors that met the threshold for co-authorship analysis

Author	Documents	Citations	Total Link Strength
Chinain, Mireille	6	148	18
Darius, Hélène Taiana	5	141	18
Hess, Philipp	5	141	18
Sibat, Manoella	4	127	16
Viallon, Jérôme	4	127	16
Ha, Sang-Do	8	410	9
Mizan, Md. Furkanur Rahaman	5	337	9
Jahid, Iqbal Kabir	4	319	8
Kim, Bong-Soo	5	66	7
Lee, Jin-Jae	4	60	7
Ma, Biao	4	65	7
Zhang, Mingzhou	4	65	7
Choi, Sang Ho	5	60	6
Yu, Xiaoping	4	63	6
Hsiao, Hsin-i	4	22	4
Karunasagar, Iddya	4	69	4
Karunasagar, Indrani	5	82	4
Ndraha, Nodali	4	22	4

Martinez-urtaza, Jaime	4	111	3
Baker-Austin, Craig	4	235	2
Li, Jianrong	6	168	2
Zhu, Junli	4	85	2
Hu, Qinghua	4	64	1
Benjakul, Soottawat	4	76	0
Cheng, Jun-hu	4	128	0
Letchumanan, Vengadesh	5	242	0
Nimrat, Subuntinth	4	13	0
Wu, Qingping	4	95	0
Xia, Xiaodong	4	78	0
Zhao, Yong	5	146	0

Of the 3187 authors, 30 meet the threshold, with the minimum number of documents of authors being 4. For each of the 30 authors, the total strength of the co-authorship links with other authors were calculated. The authors with the greater total link strength were selected. Prominent co-authors emerge from this analysis based on their superior total link strength scores, which indicate strong or wide-ranging collaborative connections. Specifically, researchers Chinnain, Mireille; Darius, Hélène Taiana; Hess, Philipp; Sibat, Manoella; and Viallon, Jérôme, each with a total link strength ranging from 16 to 18, are highlighted as central figures within the network. This designation indicates their frequent and diverse collaborative engagements, highlighting their pivotal roles in the seafood safety research community.

4.5 RQ5: What are Co-Authorship Countries' Collaboration?

Of the 83 countries, 38 meet the threshold, with the minimum of the country being 5. For each of the 38 countries, the total strength of the co-authorship links with other countries was calculated as shown in Figure 5.

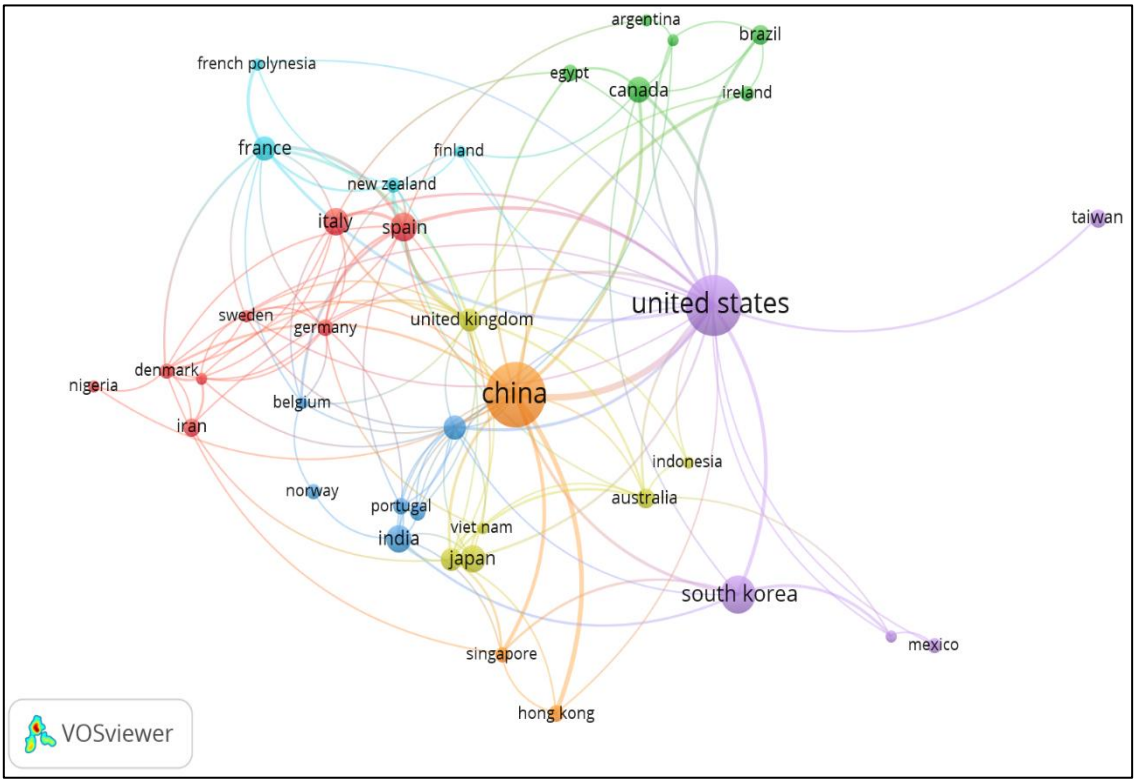

Fig. 5. Co-authorship within countries

Table 5 delineates the collaborative landscape of academic research by country, providing insights into the prolifically and reach of international co-authorship. The United States leads the chart with a formidable total link strength of 61, underpinned by 131 documents that have amassed a significant 3674 citations. This reflects the country's central role in forging robust research collaborations and its consequential impact on the academic domain.

China emerges as a close contender, showcasing substantial engagement in scholarly partnerships with a total link strength of 58, manifest in 148 documents and 2975 citations. Such figures underscore China's expansive collaborative networks and its burgeoning influence in the research community. The table also highlights the vibrant, collaborative endeavours within Europe. Countries like Spain, the United Kingdom, France and Germany exhibit a dynamic interplay of documents and citations, indicative of the thriving research collaborations across the continent. The United Kingdom, despite its considerable citation count of 563, shows a lower link strength of 27, suggesting a disparity that may be attributed to the nature or recency of its collaborative efforts. In Asia, the presence of countries such as South Korea, Malaysia, Hong Kong, India and Japan is indicative of a robust output and significant collaborative ties. Their balanced citation and document figures point to a consistent production of impactful research.

Table 5
Top 30 countries indicating collaborative landscape of academic research by country

Country	Documents	Citations	Total Link Strength
United States	131	3674	61
China	148	2975	58
Spain	31	377	28
United Kingdom	19	563	27
France	21	502	22
South Korea	52	1099	18
Malaysia	18	420	16
Canada	23	426	14
Denmark	8	287	14
Italy	26	416	14
Thailand	21	297	14
Germany	11	171	12
Singapore	9	237	12
Australia	15	310	11
Hong Kong	10	139	11
India	28	466	11
New Zealand	8	62	11
Japan	27	440	10
Austria	5	233	9
Belgium	6	162	9
Austria	5	233	9
Belgium	6	162	9
Sweden	5	173	9
Brazil	15	531	7
Bangladesh	6	219	6
Chile	5	91	6
Egypt	10	164	6
French Polynesia	5	95	6
Ireland	8	159	6
Turkey	11	148	6

Countries in the Middle East and Africa, including Egypt, Iran and Nigeria, demonstrate an active yet comparatively modest engagement in international research collaborations, as evidenced by their lower citation counts and documents. The participation of smaller regions, such as French Polynesia, is notable, proving that global collaboration transcends geographical size. This is reflected in their total link strength of 6 despite a lower document count. In the United States, the academic contributions of Canada and Brazil illustrate active research partnerships with varying scales of output and impact. Meanwhile, Mexico and Argentina, with lower link strengths, point towards a burgeoning, albeit smaller scale, of academic exchange.

Oceania focusing on Australia and New Zealand may not have the presence, in research networks in terms of quantity but it showcases strategic partnerships. The involvement of Baltic countries like Finland, Norway and Sweden alongside Asian nations such as Vietnam, Indonesia and Malaysia demonstrate the diversity and interconnectedness of international academic collaborations. This analysis not quantifies each country's research contributions but also evaluates the strength and consistency of their efforts qualitatively. The 'Total Link Strength' metric plays a role in indicating the enduring quality of research partnerships.

Examining co collaborations among countries using bibliometric data provides a holistic view of the worldwide academic research landscape underscoring the significance of international cooperation in advancing knowledge across diverse fields. This investigation uncovers the connections that transcend borders underscoring how such collaborations drive innovation and tackle complex global issues [65].

Although specific references to studies or databases for citations are not provided for the summarized data in the table this discussion aligns with common practices, in bibliometric analyses. Researchers frequently rely on information, from databases such, as Scopus or Web of Science known for their thorough inclusion of academic research. For more detailed insights into the methodologies and tools commonly employed in bibliometric analyses, including the assessment of co-authorship networks and the calculation of total link strength among countries [66,67].

4.6 RQ6: What are Co-citation Trends based on Sources?

Co-citation trends based on sources involve analysing how often different research materials, like journal articles or books, are cited together in academic studies. This method helps pinpoint influential works and authors by identifying which sources frequently appear side by side in citations. It is a way to map out how scholars in a particular field are connecting different studies and ideas, highlighting relationships and clusters of research activity. By tracking these trends over time, we can see how research interests shift, where new theories or methods are taking root and how academic focus evolves. This analysis is also great for spotting where different disciplines come together, showing us how fields blend and enhance each other's research.

The VOSviewer map presented delineates a network of sources in the domain of microbiology, with a particular emphasis on food microbiology and its environmental aspects (Figure 6). Each node represents a scientific journal or publication outlet, with the node's size indicating the volume of output or influence within the field. The connecting lines between nodes represent citation or bibliographic relationships, such as the frequency of cross-citations between journals, which signifies the level of intellectual exchange and relevance among these sources. Journals frequently citing one another are positioned in closer proximity, forming distinct clusters based on the strength and density of these connections. From the figure, the trend of resources offering the production of articles related to aspects of Foodborne Poisoning Seafoods Diseases. It has 206 items of sources categorised into 4 clusters with 8729 links and a total link strength of 236613 links.

The red group (Cluster Food Microbiology and Public Health) clearly shows that there are journals focusing on food microbiology, like "International Journal of Food Microbiology" and "Food Microbiology." The presence of journals such as "Food Control," "Toxins," and "Food Chemistry" in this group indicates a shared theme related to the safety and chemical analysis of food. “Food Control” is identified as a principal journal for the dissemination of research works, anchoring a dynamic co-citation network that fosters extensive international dialogue. On the hand the green group (Cluster Detection Methods and Food Chemistry) includes publications like " Environmental Microbiology" and "Frontiers in Microbiology " which are linked to the practical application of microbiology in environmental settings. These journals likely feature studies on how microorganisms interact within the environment concerning food production and processing. The blue group (Cluster Aquaculture) dedicated to the challenges of aquatic food production, such as disease management and environmental impacts like biofouling in aquaculture settings. The yellow group (Applied Food Safety Research) integrates scientific research with practical applications, linking food safety measures to policy and industry standards.

The lines indicate connections or shared themes between journals from groups suggesting interdisciplinary research that connects food microbiology with environmental and public health topics. This VOSviewer visualization presents an overview of the research landscape in food and environmental microbiology highlighting journals and their interconnectedness. Researchers can use this tool to identify sources for their studies understand how different research areas relate to each other and find suitable journals, for publishing their work or collaborating with others. In summary, these clusters represent the spectrum of food safety research, from the basic science of pathogens and detection methods to the applied aspects of public health and industry practices.

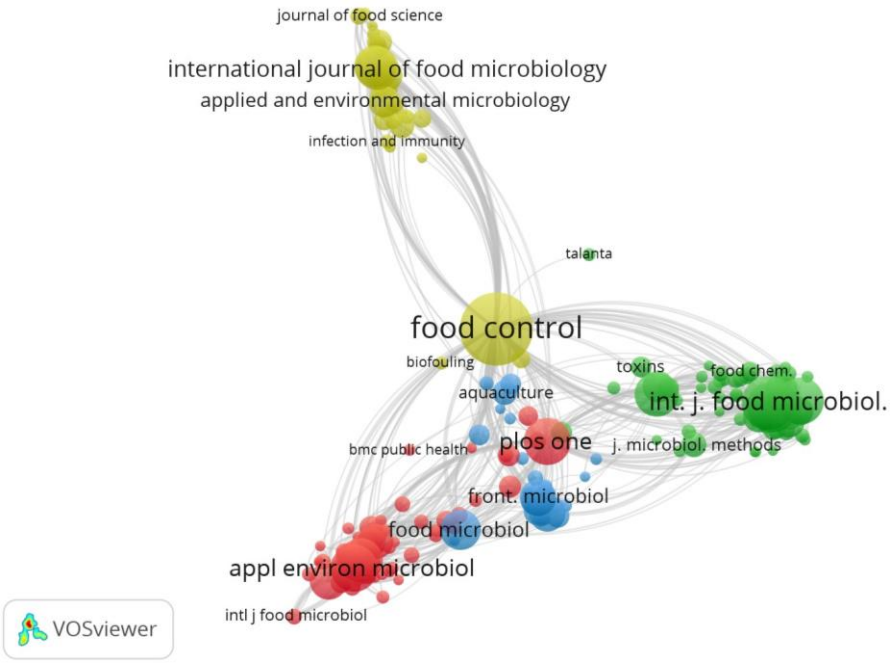

Fig. 6. Networking mapping based on co-citation by cited sources

Elbashir *et al.*, [68] provide a comprehensive review of seafoods pathogens and information on antimicrobial resistance. They address worries related to the transmission and management of pathogens, like Anisakis and Listeria which contribute to illnesses linked to seafoods consumption. This resource can be especially useful for research groups in epidemiology seafoods pathogens and resistance in aquaculture.

In another study, Dwiyitno [69] explores the use of techniques for identifying bacteria that pose risks in fish and seafoods. The paper emphasizes the role of methods such as PCR and Real time PCR in detecting pathogens in seafoods accurately. Odeyemi *et al.,* [70] explore the Prevalence of Antibiotic-Resistant Seafoods-Borne Pathogens in retail seafoods sold in Malaysia, offering a systematic review and meta-analysis on the subject. This paper adds to the discussion on antibiotics and AMR within aquaculture, making it a pertinent reference for topics on microbial resistance in aquaculture.

4.7 RQ7: What is the Co-Occurrence of Authors' Keywords Related to the Study?

The concept of "co-occurrence of authors' keywords" involves analysing how often certain keywords selected by authors appear together across academic publications. This method helps uncover connections between research topics, revealing which themes are often linked together in scholarly discussions. By observing patterns in keyword usage, researchers can spot current trends and new areas of interest in their field. This analysis is crucial for organizing the knowledge within a discipline, pinpointing primary focus areas, and identifying any research gaps. Essentially, tracking keyword co-occurrence provides valuable insights for anyone looking to understand the evolving dynamics of a field or to find potential new avenues for research.

Of the 1641 keywords, 63 keywords of the authors' keywords meet the threshold, with the minimum number of occurrences of keywords being 5. For each of the 63 keywords, the total strength of the co-occurrence links with other keywords will be calculated. The keywords with the greater total link strength were selected. There are 7 clusters with 358 links that have a total link strength of 622 documents.

Figure 7 shows the network visualisation map of the authors' keywords' co-occurrence. The figure in question is a co-occurrence map from VOSviewer, demonstrating relationships between key terms in a collection of scholarly articles. Each node, or dot, on the map symbolises a specific term, with the node's size indicating the frequency of that term in the literature. Larger nodes represent more commonly discussed topics.

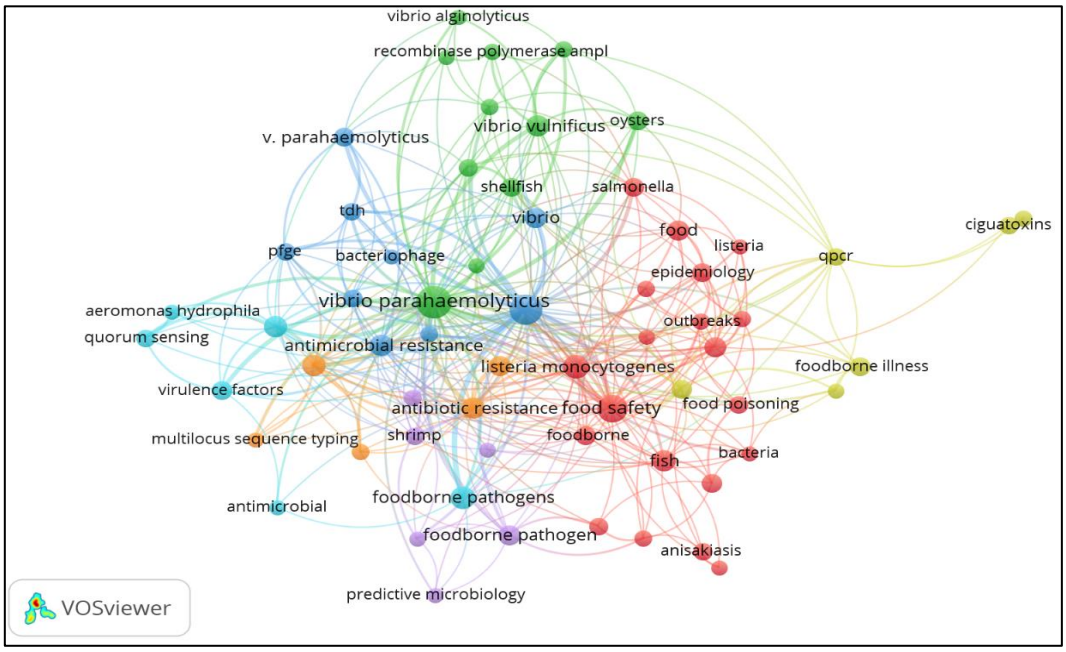

Fig. 7. Network visualization map of authors' keywords' co-occurrence

Lines connecting the nodes indicate term co-occurrence, with thicker lines suggesting terms that frequently appear together in the literature, pointing to a strong association between the topics. The nodes are colour-coded to identify clusters of related terms, each colour signifying a different group. These clusters represent research areas that are often associated with each other, such as food safety or pathogen studies. Spatial placement is also meaningful: terms that are closer to each other are usually more closely related or more often studied together. For example, a cluster with terms like "foodborne pathogen," "*Listeria monocytogenes*," and "antibiotic resistance" implies a focus on foodborne illnesses and their treatment challenges. The colour gradient at the bottom of the map might indicate a temporal trend or other data dimensions, but without additional information, its specific meaning is unclear. In essence, this map provides a visual overview of the research themes in food safety and microbiology, highlighting how frequently certain topics are mentioned and how they are interconnected in scholarly discussion.

Table 6 summarizes the cluster of author keywords' occurrence. From this table, the clusters of author keywords' occurrence, the number of keywords per cluster and the specific keywords related to foodborne illnesses in seafoods identified for bibliometric analysis. Each cluster focuses on a distinct aspect of research within the broader context of food safety and seafoods-related diseases. In the context of bibliometric analysis on foodborne illnesses in seafoods, clusters of keywords signify distinct research focuses.

Table 6
The cluster of author keywords' occurrence

Cluster	Number of Items	Keywords
1	20	Epidemiology and Pathogens in Seafoods: Anisakiasis, Anisakis, Bacteria, Epidemiology, Fish, Food, Food Poisoning, Food Borne, Foodborne Disease, Histamine, Lactic Acid Bacteria, *Listeria*, *Listeria monocytogenes*, Listeriosis, Norovirus, Outbreaks, Public Health, *Salmonella*, Seafood safety
2	11	Molecular Detection Techniques in Seafood safety: Genotyping, Oysters, PCR, Real-time PCR, Recombinase Polymerases, Shellfish, *Staphylococcus aureus*, *Vibrio alginolyticus*, *Vibrio cholerae, Vibrio parahaemolyticus*, *Vibrio vulnificus*
3	7	Microbial Resistance in Aquaculture: Antibiotic Resistance, Antimicrobial Resistance, Aquaculture, Multilocus Sequence Typing, PFGE, Prevalence, Virulence
4	7	Bacteriophage and *Vibrio* Studies: Bacteriophage, Oyster, Seafoods, tdh, *V. parahaemolyticus*, *Vibrio*, Vibriosis
5	6	Toxin and Pathogen Detection Methods: Ciguatoxins, Food Contamination, Foodborne Diseases, Foodborne Illness, LC-MS/MS, qPCR
6	7	Predictive Modelling and Genomics: Foodborne Pathogen, Predictive Microbiology, Salmon, Shrimp, Temperature, Whole Genome Sequence
7	6	Biofilm Formation and Pathogen Interaction Studies: *Aeromonas hydrophila*, Antimicrobial, Biofilm, Foodborne Pathogens, Quorum Sensing, Virulence Factors

Cluster 1 was classified as Epidemiology and Pathogens in Seafoods. This cluster investigates the spread, control and pathogens associated with seafoods-related foodborne illnesses. Meanwhile, Cluster 2 was Molecular Detection Techniques in Seafood safety for pathogen detection in seafoods, enhancing accuracy and speed in identifying safety risks. Cluster 3: Microbial Resistance in aquaculture. This cluster examines antibiotics and AMR within aquaculture, including genetic analysis of pathogens (e.g., Multilocus Sequence Typing) and the prevalence of resistance. Cluster 4: Bacteriophage and *Vibrio* Studies. This group is focused on utilizing bacteriophages to combat threats, in seafoods and studying the ecology and harmful effects of *Vibrio* species. Section 5; Identification Techniques for Toxins and Pathogens. This area involves the use of methods (such as

LC MS/MS, qPCR) to detect toxins (e.g., Ciguatoxins) and pathogens in order to safeguard seafoods. Section 6; Forecasting Models and Genomic Studies. This segment concentrates on microbiology and genetic analysis (e.g., Whole Genome Sequence) to comprehend and anticipate the behaviour of pathogens in seafoods. Section 7; Biofilm Development and Pathogen Interactions Investigates the development of biofilms by pathogens (*Aeromonas hydrophila*) delves into tactics and examines the factors that influence pathogen conduct. Each section addresses an aspect of research on illnesses in seafoods covering pathogen identification, epidemiology, resistance management and enhancements, in food safety measures.

Efforts to control foodborne pathogens in seafood align closely with Sustainable Development Goal 14 (SDG 14): Life Below Water. This goal addresses critical global and climate challenges affecting both developing and developed nations [71]. Failure to meet SDG 14 targets could worsen conditions in developing countries, requiring more resources to address consequences [71]. The issue's growing relevance to developed nations highlights its global importance in preserving marine ecosystems and ensuring sustainable seafood production.

5. Conclusions

In summary, this study has shed light on an increase, in research focusing on illnesses related to seafoods highlighting the global importance of implementing food safety measures. Countries such as the United States, China, the United Kingdom, France, South Korea and Malaysia are at the forefront of this research with contributions. Analysis of publication trends from 2013 to 2023 reveals a rise in interest with a slight dip in 2022 but overall showing dedication within the academic community. The journal "Food Control" plays a role in disseminating discoveries and fostering collaboration among leading nations. Seven key research areas have been identified, including epidemiology, molecular detection techniques, microbial resistance studies, bacteriophage and *Vibrio* research, toxin and pathogen detection methods, predictive modelling and genomics studies and biofilm research. These areas represent the forefront of research efforts. Suggest important directions for future investigations. Progress in these fields is essential for gaining insights, into seafoods related diseases and effectively managing them. The research emphasizes the need, for global collaboration, in studies to improve seafood safety measures. By working across borders and focusing on policy outcomes scientists worldwide can better protect health from foodborne illnesses linked to seafoods consumption. The findings of this study suggest the importance of a cohesive and strategic research plan to drive progress in ensuring seafood safety.

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References
[1] Yu, Hang, Yang Liu, Lu Li, Yahui Guo, Yunfei Xie, Yuliang Cheng, and Weirong Yao. "Ultrasound-involved emerging strategies for controlling foodborne microbial biofilms." *Trends in Food Science & Technology* 96 (2020): 91-101. https://doi.org/10.1016/j.tifs.2019.12.010

[2] Smith, B. A., S. Meadows, R. Meyers, E. J. Parmley, and A. Fazil. "Seasonality and zoonotic foodborne pathogens in Canada: relationships between climate and Campylobacter, E. coli and Salmonella in meat products." *Epidemiology & Infection* 147 (2019): e190. https://doi.org/10.1017/S0950268819000797

[3] Food Agriculture Organization of United Nation. "The State of Food Security and Nutrition in The Worlds Building Climate Resilience for Food Security and Nutrition." *Rome: UNICEF.* (2018). https://www.fao.org/3/i9553en/i9553en.pdf

[4] Jones, Shawn W., Alon Karpol, Sivan Friedman, Biniam T. Maru, and Bryan P. Tracy. "Recent advances in single cell protein use as a feed ingredient in aquaculture." *Current opinion in biotechnology* 61 (2020): 189-197. https://doi.org/10.1016/j.copbio.2019.12.026

[5] Torgerson, Paul R., Brecht Devleesschauwer, Nicolas Praet, Niko Speybroeck, Arve Lee Willingham, Fumiko Kasuga, Mohammad B. Rokni *et al.,* "World Health Organization estimates of the global and regional disease burden of 11 foodborne parasitic diseases, 2010: a data synthesis." *PLoS medicine* 12, no. 12 (2015): e1001920. https://doi.org/10.1371/journal.pmed.1001920

[6] Martinez-Urtaza, Jaime, Joaquin Trinanes, Michel Abanto, Antonio Lozano-Leon, Jose Llovo-Taboada, Marta Garcia-Campello, Anxela Pousa, Andy Powell, Craig Baker-Austin, and Narjol Gonzalez-Escalona. "Epidemic dynamics of Vibrio parahaemolyticus illness in a hotspot of disease emergence, Galicia, Spain." *Emerging infectious diseases* 24, no. 5 (2018): 852. https://doi.org/10.3201/eid2405.171700

[7] Osman, Faridah, Mohd Nizam Lani, Nik Hafizah Nik Ubaidillah, Mohd Yahya Fadzli Jusoh, Roshita Ibrahim, and Vira Putri Yarlina. "Effects of Acidic Ingredients on the Microbial Quality, Sensory Acceptance and Shelf Life of Chilli Shrimp Paste." *International Journal of Advanced Research in Food Science and Agriculture Technology* 2, no. 1 (2024): 40-53. https://doi.org/10.37934/fsat.2.1.4053

[8] Muktiarni, M., Nur Indri Rahayu, Ai Nurhayati, Andika Dutha Bachari, and Affero Ismail. "Concept of computational fluid dynamics design and analysis tool for food industry: A bibliometric." *CFD Letters* 16, no. 2 (2024): 1-23. https://doi.org/10.37934/cfdl.16.2.123

[9] Mariappan, Punithavili, Mohd Zahuri Khairani, Norzuraina Mohd, Maran Chanthiran, and Andy Noces Cubalit. "Uncovering Emerging Trends in Technology and Art Education: A Bibliometric Mapping Analysis." *Journal of Advanced Research in Applied Sciences and Engineering Technology* 41, no. 1 (2024): 64-75. https://doi.org/10.37934/araset.41.1.6475

[10] Nguyen, Ly, Zhifeng Gao, and James L. Anderson. "Perception shifts in seafood consumption in the United States." *Marine Policy* 148 (2023): 105438. https://doi.org/10.1016/j.marpol.2022.105438

[11] Lebelo, Kgomotso, Muthoni Masinde, Ntsoaki Malebo, and Mokgaotsa Jonas Mochane. "The surveillance and prediction of food contamination using intelligent systems: a bibliometric analysis." *British Food Journal* 124, no. 4 (2022): 1149-1169. https://doi.org/10.1108/BFJ-04-2021-0366

[12] Baker-Austin, Craig, Joaquin Trinanes, Narjol Gonzalez-Escalona, and Jaime Martinez-Urtaza. "Non-cholera vibrios: the microbial barometer of climate change." *Trends in microbiology* 25, no. 1 (2017): 76-84. https://doi.org/10.1016/j.tim.2016.09.008

[13] Hirshfeld, Brady, Kurtis Lavelle, Katie Yen Lee, Edward Robert Atwill, David Kiang, Bakytzhan Bolkenov, Megan Gaa *et al.,* "Prevalence and antimicrobial resistance profiles of Vibrio spp. and Enterococcus spp. in retail shrimp in Northern California." *Frontiers in Microbiology* 14 (2023): 1192769. https://doi.org/10.3389/fmicb.2023.1192769

[14] Vijayam, Bhuwaneswaran, Siew Ping Lau, Jing Wen Wong, Sakinah Muzarpar, Ainun Amirah Abdul Rahim, Jia Yee Pwi, and Leeynesh Sooriyapiragasam. "Validation of glycemic index values represented as bar graphs in scholarly articles for clinical nutrition application." *Journal of Health and Quality of Life* 1, no. 1 (2024): 1-15. https://doi.org/10.37934/hqol.1.1.115

[15] Ridzuan, Mohamad Ikhram Mohamad, Azizan Morshidi, Noor Syakirah Zakaria, Ramli Dollah, Ang Kean Hua, and Mohamad Pirdaus Yusoh. "Policy Constructivity and Food Security Strategies: Vulnerability Issues of Rice in Kota Belud, Sabah." *International Journal of Advanced Research in Food Science and Agriculture Technology* 1, no. 1 (2024): 14-30. https://doi.org/10.37934/fsat.1.1.1430

[16] Chen, Yubing, Wenqing Li, Keming Shi, Zheng Fang, Yunlan Yang, and Rui Zhang. "Isolation and characterization of a novel phage belonging to a new genus against Vibrio parahaemolyticus." *Virology Journal* 20, no. 1 (2023): 81. https://doi.org/10.1186/s12985-023-02036-9

[17] Palamae, Suriya, Ajay Mittal, Jirayu Buatong, Bin Zhang, Hui Hong, and Soottawat Benjakul. "Chitooligosaccharide-catechin conjugate: Antimicrobial mechanisms toward Vibrio parahaemolyticus and its use in shucked Asian green mussel." *Food Control* 151 (2023): 109794. https://doi.org/10.1016/j.foodcont.2023.109794

[18] Yu, Hary, and Min Suk Rhee. "Characterization of ready-to-eat fish surface as a potential source of contamination of Vibrio parahaemolyticus biofilms." *Food Research International* 169 (2023): 112890. https://doi.org/10.1016/j.foodres.2023.112890

[19] Fehrenbach, Gustavo Waltzer, Emma Murphy, Robert Pogue, Frank Carter, Eoghan Clifford, Ian Major, and Neil Rowan. "Pulsed ultraviolet (PUV) disinfection of artificially contaminated seawater seeded with high levels of pathogen disease indicators as an alternative for the shellfish industry depuration systems." *Environmental Science and Pollution Research* 30, no. 27 (2023): 70771-70782. https://doi.org/10.1007/s11356-023-27286-6

[20] Ahmad, F T, M N Lani, S A Nazari, N H M Hajar, K.N.A.M. Hassan, S B A Razak, and Z Hassan. "Antioxidant and Antimicrobial Properties of Honey, Propolis and Bee Bread of Stingless Bee (Geniotrigona thoracica)." *Asian Journal of Agriculture and Biology 7 (Special Issue)*, (2019):76–85.

[21] Hasali, Nor Hazwani, Amir Izzwan Zamri, Mohd Nizam Lani, And Aidilla Mubarak. "Antibiotic susceptibility, antibacterial activity and probiotic characterisation of isolated Lactobacillus brevis strains from Heterotrigona itama honey." *Malaysian Applied Biology* 47, no. 6 (2018): 105-112.
[22] Hassan, Z., M. N. Lani, S. B. A. Razak, F. T. Ahmad, and A. L. Mahmood. "Antioxidant and antimicrobial properties of Indo-Malayan stingless bee (Heterotrigona itama) honey from different seasons and distribution of flowers." *Food Research (Malaysia)* (2021).
[23] Lee, Hye-Jeong, Julia E. Storesund, Bjørn-Tore Lunestad, Sunniva Hoel, Jørgen Lerfall, and Anita Nordeng Jakobsen. "Whole genome sequence analysis of Aeromonas spp. isolated from ready-to-eat seafood: antimicrobial resistance and virulence factors." *Frontiers in Microbiology* 14 (2023): 1175304. https://doi.org/10.3389/fmicb.2023.1175304
[24] Marquis, Grace E., Samantha M. Covaia, Amanda M. Tabb, Courtney J. Kitch, and Rosalee S. Hellberg. "Microbiological safety and quality of ceviche, poke, and sushi dishes sold at retail outlets in Orange County, CA." *Heliyon* 9, no. 6 (2023). https://doi.org/10.1016/j.heliyon.2023.e16862
[25] Ma, Jiaqi, Lingyun Meng, Sai Wang, Jiao Li, and Xiangzhao Mao. "Inactivation of Vibrio parahaemolyticus and retardation of quality loss in oyster (Crassostrea gigas) by ultrasound processing during storage." *Food Research International* 168 (2023): 112722. https://doi.org/10.1016/j.foodres.2023.112722
[26] Guedes, Bárbara, Ofélia Godinho, Olga Maria Lage, and Sandra Quinteira. "Microbiological quality, antibiotic resistant bacteria and relevant resistance genes in ready-to-eat Pacific oysters (Magallana gigas)." *FEMS Microbiology Letters* 370 (2023): fnad053. https://doi.org/10.1093/femsle/fnad053
[27] Frith, Ashley, Marlee Hayes-Mims, Ruth Carmichael, and Kristin Björnsdóttir-Butler. "Effects of Environmental and Water Quality Variables on Histamine-Producing Bacteria Concentration and Species in the Northern Gulf of Mexico." *Microbiology Spectrum* 11, no. 4 (2023): e04720-22. https://doi.org/10.1128/spectrum.04720-22
[28] Su, Yi-Cheng, Qianru Yang, and Claudia Häse. "Refrigerated seawater depuration for reducing Vibrio parahaemolyticus contamination in Pacific oyster (Crassostrea gigas)." *Journal of food protection* 73, no. 6 (2010): 1111-1115. https://doi.org/10.4315/0362-028X-73.6.1111
[29] Aisyah, Faten Nur, Sharifah Noor Emilia, Babul Atiqah Othman, and Aisyah Najiah Mohd Azmi. "Isolation and Characterization of Beneficial Bacteria in the Guts of Cultured Sturgeon." *Semarak International Journal of Agriculture, Forestry and Fisheries* 1, no. 1 (2024): 30-42. https://doi.org/10.37934/sijaff.1.1.3042
[30] Yunos, Yusnenti Faziran Mohd, Mohd Yusri Ibrahim, and Khalid Husseine Tuah. "Odorless Probiotic Chicken of Eco-Smart Poultry Coop." *International Journal of Advanced Research in Food Science and Agriculture Technology* 2, no. 1 (2024): 1-7. https://doi.org/10.37934/fsat.2.1.17
[31] Bakar, Nurul Syahida Abu, Wan Fairos Wan Yaacob, Yap Bee Wah, Wan Marhaini Wan Omar, and Utriweni Mukhaiyar. "Visualising Current Research Trends in Class Imbalance using Clustering Approach: A Bibliometrics Analysis." *Journal of Advanced Research in Applied Sciences and Engineering Technology* 38, no. 2 (2024): 95-111. https://doi.org/10.37934/araset.38.2.95111
[32] Nandiyanto, Asep Bayu Dani, Dwi Fitria Al Husaeni, and Dwi Novia Al Husaeni. "Introducing ASEAN Journal for Science and Engineering in Materials: Bibliometric Analysis." *Journal of Advanced Research in Applied Mechanics* 112, no. 1 (2024): 102-113. https://doi.org/10.37934/aram.112.1.102113
[33] Dehdarirad, Tahereh, Hajar Sotudeh, and Jonathan Freer. "Bibliometric mapping of microbiology research topics (2012–16): a comparison by socioeconomic development and infectious disease vulnerability values." *FEMS microbiology letters* 366, no. 2 (2019): fnz004. https://doi.org/10.1093/femsle/fnz004
[34] Borgohain, Dhruba Jyoti, Mohammad Nazim, and Manoj Kumar Verma. "Cluster analysis and network visualization of research in mucormycosis: a scientometric mapping of the global publications from 2011 to 2020." *Library Hi Tech* 42, no. 1 (2024): 54-78. https://doi.org/10.1108/LHT-04-2022-0171
[35] Julius, Rafael, Muhammad Syawal Abd Halim, Normi Abdul Hadi, Azrul Nizam Alias, Muhammad Hafiz Mohd Khalid, Zulfadli Mahfodz, and Fariesha Farha Ramli. "Bibliometric analysis of research in mathematics education using Scopus database." *Eurasia Journal of Mathematics, Science and Technology Education* 17, no. 12 (2021). https://doi.org/10.29333/ejmste/11329
[36] Al-Khoury, Abeer, Sahraa Anwer Hussein, Muthana Abdulwhab, Zainab M. Aljuboori, Hossam Haddad, Mostafa A. Ali, Ibtihal A. Abed, and Hakeem Hammood Flayyih. "Intellectual capital history and trends: A bibliometric analysis using scopus database." *Sustainability* 14, no. 18 (2022): 11615. https://doi.org/10.3390/su141811615
[37] Thottoli, Mohammed Muneerali, Md Aminul Islam, Farid Ahammad Sobhani, Shafiqur Rahman, and Md Sharif Hassan. "Auditing and sustainability accounting: A global examination using the Scopus database." *Sustainability* 14, no. 23 (2022): 16323. https://doi.org/10.3390/su142316323
[38] Izhar, Nurul Ashikin, Nor Asniza Ishak, and Siti Mastura Baharudin. "A bibliometric analysis of 21st century learning using scopus database." *International Journal of Learning, Teaching and Educational Research* 22, no. 3 (2023): 225-240. https://doi.org/10.26803/ijlter.22.3.14

[39] Pham-Duc, Binh, Trung Tran, Dung Huu Hoang, and Chau Bao Do. "Global scientific literature on human resource development: a bibliometric analysis using Scopus database." *European Journal of Training and Development* 47, no. 7/8 (2023): 846-861. https://doi.org/10.1108/EJTD-01-2022-0004

[40] Khudzari, Jauharah Md, Jiby Kurian, Boris Tartakovsky, and GS Vijaya Raghavan. "Bibliometric analysis of global research trends on microbial fuel cells using Scopus database." *Biochemical engineering journal* 136 (2018): 51-60. https://doi.org/10.1016/j.bej.2018.05.002

[41] Medias, Fahmi, Reni Rosari, Akhmad Akbar Susamto, and Asmak Binti Ab Rahman. "A bibliometric analysis on innovation in philanthropy research: a study based on Scopus database." *International Journal of Innovation Science* 16, no. 4 (2024): 748-771. https://doi.org/10.1108/IJIS-08-2022-0139

[42] Shaifudin, Muhamad Syaizwadi, Wan Mohamad Ikhmal Wan Mohamad Kamaruzzaman, Malia Athirah Badruddin, Abdul Muiz Aniq Aiman Mohd Suhaimi, Nursabrina Amirah Mohd Nasir, Nur Aiman Syafiq Mohd Hamidi, Wan Rafizah Wan Abdullah, Oon Jew Lee, and Mohd Sabri Mohd Ghazali. "Exploring the global publications on varistors using the Scopus database through a bibliometric analysis." *Journal of Asian Ceramic Societies* 10, no. 2 (2022): 438-452. https://doi.org/10.1080/21870764.2022.2068748

[43] Verbeek, Arnold, Koenraad Debackere, Marc Luwel, and Edwin Zimmermann. "Measuring progress and evolution in science and technology–I: The multiple uses of bibliometric indicators." *International Journal of management reviews* 4, no. 2 (2002): 179-211. https://doi.org/10.1111/1468-2370.00083

[44] Li, Chenxi, Kening Wu, and Jingyao Wu. "A bibliometric analysis of research on haze during 2000–2016." *Environmental Science and Pollution Research* 24 (2017): 24733-24742. https://doi.org/10.1007/s11356-017-0440-1

[45] Fahimnia, Behnam, Joseph Sarkis, and Hoda Davarzani. "Green supply chain management: A review and bibliometric analysis." *International journal of production economics* 162 (2015): 101-114. https://doi.org/10.1016/j.ijpe.2015.01.003

[46] Gao, Shang, Fanchen Meng, Zhouyang Gu, Zhiyuan Liu, and Muhammad Farrukh. "Mapping and clustering analysis on environmental, social and governance field a bibliometric analysis using Scopus." *Sustainability* 13, no. 13 (2021): 7304. https://doi.org/10.3390/su13137304

[47] Van Eck, Nees Jan, Ludo Waltman, Rommert Dekker, and Jan Van Den Berg. "A comparison of two techniques for bibliometric mapping: Multidimensional scaling and VOS." *Journal of the American Society for Information Science and Technology* 61, no. 12 (2010): 2405-2416. https://doi.org/10.1002/asi.21421

[48] Appio, Francesco Paolo, Antonella Martini, Silvia Massa, and Stefania Testa. "Unveiling the intellectual origins of social media-based innovation: insights from a bibliometric approach." *Scientometrics* 108 (2016): 355-388. https://doi.org/10.1007/s11192-016-1955-9

[49] Fleming, Lora E., Dolores Katz, Judy A. Bean, and Roberta Hammond. "Epidemiology of seafood poisoning." In *Foodborne Disease Handbook*, pp. 287-310. CRC Press, 2018.

[50] Sioen, Isabelle, Stefaan De Henauw, John Van Camp, Jean-Luc Volatier, and Jean-Charles Leblanc. "Comparison of the nutritional–toxicological conflict related to seafood consumption in different regions worldwide." *Regulatory Toxicology and Pharmacology* 55, no. 2 (2009): 219-228. https://doi.org/10.1016/j.yrtph.2009.07.003

[51] Page, Samuel W., and FOOD AND DRUG ADMINISTRATION WASHINGTONDC. *Collaborative Research Program on Seafood Toxins*. 1988. https://doi.org/10.21236/ADA260073

[52] Pollock, G. A., I. J. Uhaa, and A. Wieder. "Factors Involved In Human Health Based Study Design Of Chemical Contamination Of Fish: The California Department Of Health Services' Study Of Southern California." In *Proceedings OCEANS*, vol. 2, pp. 670-675. IEEE, 1989. https://doi.org/10.1109/OCEANS.1989.586841

[53] Sioen, Isabelle, Stefaan De Henauw, John Van Camp, Jean-Luc Volatier, and Jean-Charles Leblanc. "Comparison of the nutritional–toxicological conflict related to seafood consumption in different regions worldwide." *Regulatory Toxicology and Pharmacology* 55, no. 2 (2009): 219-228. https://doi.org/10.1016/j.yrtph.2009.07.003

[54] Hall, Richard L. "What will food science require of toxicology?." *Fundamental and Applied Toxicology* 4, no. 3 (1984): S278-S283. https://doi.org/10.1016/0272-0590(84)90253-7

[55] Dehghani, Samira, Seyed Vali Hosseini, and Joe M. Regenstein. "Edible films and coatings in seafood preservation: A review." *Food chemistry* 240 (2018): 505-513. https://doi.org/10.1016/j.foodchem.2017.07.034

[56] Elmahdi, Sara, Ligia V. DaSilva, and Salina Parveen. "Antibiotic resistance of Vibrio parahaemolyticus and Vibrio vulnificus in various countries: a review." *Food microbiology* 57 (2016): 128-134. https://doi.org/10.1016/j.fm.2016.02.008

[57] Everstine, Karen, John Spink, and Shaun Kennedy. "Economically motivated adulteration (EMA) of food: common characteristics of EMA incidents." *Journal of food protection* 76, no. 4 (2013): 723-735. https://doi.org/10.4315/0362-028X.JFP-12-399

[58] Ferrari, Rafaela G., Denes KA Rosario, Adelino Cunha-Neto, Sérgio B. Mano, Eduardo ES Figueiredo, and Carlos A. Conte-Junior. "Worldwide epidemiology of Salmonella serovars in animal-based foods: a meta-analysis." *Applied and environmental microbiology* 85, no. 14 (2019): e00591-19. https://doi.org/10.1128/AEM.00591-19

[59] Letchumanan, Vengadesh, Wai-Fong Yin, Learn-Han Lee, and Kok-Gan Chan. "Prevalence and antimicrobial susceptibility of Vibrio parahaemolyticu s isolated from retail shrimps in Malaysia." *Frontiers in microbiology* 6 (2015): 33. https://doi.org/10.3389/fmicb.2015.00033

[60] Wang, Chung-Yi, Hsiao-Wen Huang, Chiao-Ping Hsu, and Binghuei Barry Yang. "Recent advances in food processing using high hydrostatic pressure technology." *Critical Reviews in Food Science and Nutrition* 56, no. 4 (2016): 527-540. https://doi.org/10.1080/10408398.2012.745479

[61] Lung, Hsiang-Mei, Yu-Chi Cheng, Yin-Hsuan Chang, Hsiao-Wen Huang, Binghuei Barry Yang, and Chung-Yi Wang. "Microbial decontamination of food by electron beam irradiation." *Trends in Food Science & Technology* 44, no. 1 (2015): 66-78. https://doi.org/10.1016/j.tifs.2015.03.005

[62] Baptista, Rafaela C., Claudia N. Horita, and Anderson S. Sant'Ana. "Natural products with preservative properties for enhancing the microbiological safety and extending the shelf-life of seafood: A review." *Food research international* 127 (2020): 108762. https://doi.org/10.1016/j.foodres.2019.108762

[63] Baker-Austin, Craig, and James D. Oliver. "Vibrio vulnificus: new insights into a deadly opportunistic pathogen." *Environmental microbiology* 20, no. 2 (2018): 423-430. https://doi.org/10.1111/1462-2920.13955

[64] Taylor, Ethel V., Karen M. Herman, E. C. Ailes, C. Fitzgerald, J. S. Yoder, B. E. Mahon, and R. V. Tauxe. "Common source outbreaks of Campylobacter infection in the USA, 1997–2008." *Epidemiology & Infection* 141, no. 5 (2013): 987-996. https://doi.org/10.1017/S0950268812001744

[65] Van Eck, Nees, and Ludo Waltman. "Software survey: VOSviewer, a computer program for bibliometric mapping." *scientometrics* 84, no. 2 (2010): 523-538. https://doi.org/10.1007/s11192-009-0146-3

[66] Waltman, Ludo, Nees Jan Van Eck, and Ed CM Noyons. "A unified approach to mapping and clustering of bibliometric networks." *Journal of informetrics* 4, no. 4 (2010): 629-635. https://doi.org/10.1016/j.joi.2010.07.002

[67] Leydesdorff, Loet, and Ismael Rafols. "A global map of science based on the ISI subject categories." *Journal of the American Society for Information Science and Technology* 60, no. 2 (2009): 348-362. https://doi.org/10.1002/asi.20967

[68] Elbashir, S., Sa Parveen, Ja Schwarz, Ta Rippen, Mb Jahncke, and Ac DePaola. "Seafood pathogens and information on antimicrobial resistance: A review." *Food microbiology* 70 (2018): 85-93. https://doi.org/10.1016/j.fm.2017.09.011

[69] Dwiyitno, D. "'Pathogenic bacteria, fish, DNA molecular, PCR'." *Bulletin of Marine and Fisheries Postharvest and Biotechnology* 5, no. 2 (2010). https://doi.org/10.15578/squalen.v5i2.49

[70] Odeyemi, Omowale A., Muhamad Amin, Fera R. Dewi, Nor Azman Kasan, Helen Onyeaka, Deyan Stratev, and Olumide A. Odeyemi. "Prevalence of Antibiotic-Resistant Seafood-Borne Pathogens in Retail Seafood Sold in Malaysia: A Systematic Review and Meta-Analysis." *Antibiotics* 12, no. 5 (2023): 829. https://doi.org/10.3390/antibiotics12050829

[71] In, Jenny. "Suggesting Priorities of Sustainable Development Goals Considering the Lingering Impacts of COVID-19." *Journal of Health and Quality of Life* 3, no. 1 (2024): 1-12. https://doi.org/10.37934/jhqol.3.1.112