

A Bibliometric Analysis of Trends in Food Safety Research: The Case of Chili Sauce

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ABSTRACT

This study examines the literature on the case study of food safety in chili sauce using bibliometric analysis focused on documents, keywords, and mapping the relationship between food safety and chili sauce. Bibliographic information from relevant research articles and conference papers was obtained from the Scopus database. In total, 664 articles published between 2019 and 2023 were selected, covering 2,755 keywords. The data were analyzed bibliometrically using Vosviewer 1.6.16. Out of the 664 published articles on chili sauce, 352 of them focused on the food safety of chili sauce. The results revealed nine distinct clusters encompassing aspects such as microbiological safety, chemical contaminants, allergenic substances, quality and shelf-life, and good manufacturing practices. By identifying the most popular and influential keywords, this research provides a better understanding of the relevant research focus. This information can be utilized to develop risk control strategies, and food safety standards, and enhance the overall quality and safety of chili sauce.

Keywords: Bibliometric, chili sauce, food safety, Scopus database, vosviewers.

INTRODUCTION

In the era of globalization and increased human mobility, food safety has become an increasingly important issue that requires special attention. One important aspect of food safety is the monitoring and analysis of food products consumed by the public. Chili sauce, as one of the most commonly consumed food products worldwide, has been the focus of research in the context of food safety.

Chili sauce is a condiment made from chili peppers that are processed into a paste or liquid form. It is often used as a seasoning or addition to food to provide a spicy taste and refreshing aroma. The presence of chili sauce is not limited to a single culture or region but has spread to various countries and is found in various variants and levels of spiciness.

However, despite the high popularity and consumption of chili sauce, cases of food safety issues related to chili sauce have also emerged. Some cases of food contamination and poisoning have been reported, which are related to chili sauce that does not meet food safety standards.

Contamination of chili sauce can occur through several mechanisms, such as the contamination of pathogenic microorganisms like Salmonella or E. coli, the use of contaminated raw materials, or the use of unsafe additives. In addition, factors such as poor sanitation conditions during the production or handling of chili sauce, improper preservation processes, and the misuse of chemicals in production can also lead to food safety problems.

In addition to cases of food contamination and poisoning, the food safety of chili sauce can also be related to issues of adulteration and authentication. Adulteration refers to dishonest or fraudulent actions in the food industry, where ingredients or components that should not be present or are not following the product label are intentionally added. In the case of chili sauce, adulteration can occur by adding undisclosed ingredients

to the label, such as adding artificial colors or unauthorized preservatives. Some examples of substances that are often illegally added include textile dyes or toxic compounds. Adulteration of chili sauce can have negative impacts on consumer health, reduce product quality, and harm honest producers.

Cases of food safety related to chili sauce have raised concerns and attention from various parties, including the government, producers, and consumers. To improve the food safety of chili sauce, research, and scientific analysis are crucial. Bibliometric analysis can help identify research trends, highlight areas of focus, and identify knowledge gaps that need further investigation.

Through bibliometric analysis of the food safety of chili sauce, we can gain a better understanding of the research efforts that have been conducted to enhance the safety of this product. The data and information obtained through this analysis can be used as a basis for formulating more effective policies and guidelines in the supervision and control of the food safety of chili sauce.

MATERIALS AND METHODS

Information regarding the food safety of chili sauce was obtained from the Scopus database. References from Scopus were chosen due to their extensive and comprehensive collection of scientific literature compared to other databases such as Web of Science (Bamel et al., 2020);(Khitous et al., 2020). Google Scholar was not utilized as it did not provide the detailed information required for network analysis, such as bibliometric approaches (Bamel et al., 2020). To conduct the search in the Scopus database, the following keywords were employed: “chili sauce” and “food safety of chili sauce”. The scientific literature sought should include these keywords, terms, or phrases in the title, abstract, or keywords. We will analyze the complete texts of the literature that meet the predetermined inclusion and exclusion criteria. The inclusion criteria encompass literature sourced from the Scopus database, comprising original articles or conference papers, and written in the English language and scientific literature with irrelevant terms. As for the exclusion criteria, it involves inadequate information or articles lacking full text.

This research has established the research scope and generated papers through data extraction and analysis, as illustrated in Figure 1. Subsequently, the relevant literature collected from the database was saved in the “RIS” format and imported into the similarity viewer software (Vosviewer) 1.6.16 for additional bibliometric analysis (Valdiani et al., 2012). Various parameters were evaluated to examine the results, including publication trends, analysis of contributing countries, analysis of contributing institutions, analysis of contributing publishers, analysis of authors and their bibliographical coupling network, analysis of the most influential paper and its co-citation network, keyword co-occurrence network and overlay, as well as considerations related to food safety.

The VOSviewer software performs the extraction and analysis of words found in the title, abstract, and keywords of eligible literature. The results are then visualized as bubble maps representing specific terms or phrases (Yeung et al., 2018). Manual inspection is conducted to remove generic or irrelevant terms (Yeung et al., 2018). The size of the bubbles indicates the number of occurrences of the words in the literature. The color of the bubbles indicates the number of citations per publication containing the respective term, while the proximity of the two bubbles illustrates the frequency of co-occurrence between the two terms (Yeung et al., 2021) (Yeung et al., 2018).

RESULT AND DISCUSSION

Keyword Co-Occurrence Network and Overlay

A co-occurrence network and overlay of keywords can be employed to identify the most popular and influential terms. This approach offers a quick, objective, and reproducible means of gaining insights into

the primary research topics within the field (Bamel et al., 2020); (Grames et al., 2019). To conduct this network analysis, keywords, and their co-occurrences are extracted from titles, abstracts, and keywords in various publications, with authors providing both author keywords and indexed keywords (Bamel et al., 2020); (Grames et al., 2019). Each node in the network visualization represents potential keywords and the co-occurrence relationships (Grames et al., 2019).

We adopted fractional counting to construct the co-occurrence network of keywords, as it allows for the normalization of link weights and yields more realistic results. This approach elucidates the structure within the network (Vargas-Quesada et al., 2017) The analysis offers three options for the unit of analysis: author keywords, indexed keywords, and all keywords (comprising both author and indexed keywords). Therefore, we utilized all keywords. Author keywords provide insights into the authors themselves (expressed through natural language terms), while indexed keywords provide an interpretation of the content (Vargas-Quesada et al., 2017). Previous studies have indicated that author keywords are effective in investigating the knowledge structure of a field in bibliometric analysis; however, they may be biased as some researchers employ specific keywords to enhance the visibility of their papers (Bonaccorsi, 2008); (Vargas-Quesada et al., 2017); (Zhao et al., 2022)(Liu, 2013). Additionally, indexed keywords offer comprehensive coverage for visualizing article content (Vargas-Quesada et al., 2017). Hence, we utilized a combination of author keywords and indexed keywords (i.e., all keywords). Subsequently, duplicate keywords were removed to optimize this approach (Vargas-Quesada et al., 2017).

This visualization unveiled 2,755 keywords from 664 selected documents. Initially, when a single keyword was set as the minimum occurrence requirement, 2,755 keywords met the criteria. However, the program selected only 1,000 keywords. Therefore, we raised the minimum requirement to 3 keywords, resulting in 175 keywords meeting the threshold. Out of 175 connected keywords, the program indicates that only 173 keywords can be connected to each other, resulting in a display of 173 keywords.

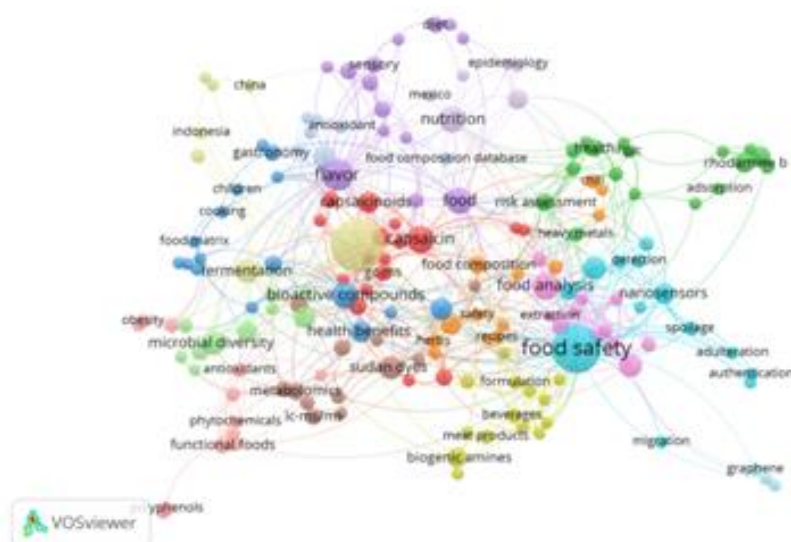


Figure 1. Keyword co-occurrence network.

The findings from the keyword co-occurrence network are displayed in Figure 1. The proximity between nodes reflects the interconnectedness of the keywords in terms of information. Simultaneously, the node size corresponds to the frequency of keyword occurrences (Bamel et al., 2020). Furthermore, the overlapping nodes indicate the frequency of keyword co-occurrences within the network (Bamel et al., 2020). This visualization reveals that the keyword co-occurrence network consists of nine clusters, each distinguished by distinct colors: Blue, yellow, red, purple, green, dark blue, orange, brown, and pink.

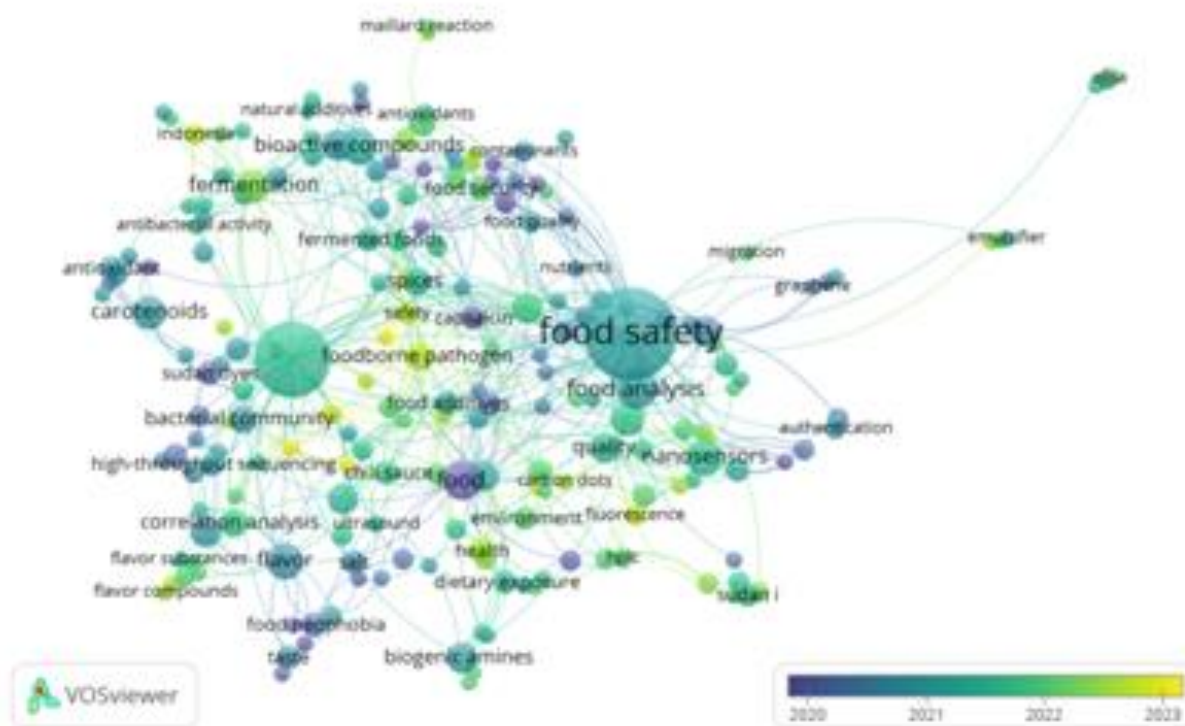


Figure 2. Keyword co-occurrence overlay with a time frame.

Figure 2 displays keywords that co-occur within a time frame. The node size reveals the frequency of keyword occurrences. The node color indicates the average publication year of the keywords (Bamel et al., 2020). The color of the nodes reveals the average publication year of the keyword where purple, purple-green, green, green-yellow, and yellow were used around/ before 2020; around 2021,0; around 2021,5; around 2022,0; and around/ after 2022,5.

Food Safety Studies

Food safety research on chili sauce has been a major concern in recent years. Various studies have been conducted to analyze the safety risks associated with chili sauce, risk control methods, as well as applicable regulations and food safety standards. Some of the food safety issues that have been investigated include Microbiological safety: Studies have examined the presence of pathogenic microorganisms such as Salmonella, Escherichia coli, and Listeria monocytogenes in chili sauce. These microorganisms can pose significant health risks if present in contaminated products. Chemical contaminants: Research has focused on identifying and quantifying potential chemical contaminants in chili sauce, such as pesticides, heavy metals (e.g., lead, cadmium), mycotoxins, and adulterants. These contaminants can enter the sauce during cultivation, processing, or packaging, and may pose health hazards if consumed. Allergenic substances: Investigations have been conducted to identify allergenic ingredients in chili sauce, such as peanuts, soy, or gluten, which can cause allergic reactions in susceptible individuals. Labeling and detection methods for allergenic substances have also been studied. Quality and shelf-life: Studies have explored the effects of different processing and storage conditions on the quality and shelf-life of chili sauce. Factors such as pH, temperature, packaging materials, and storage duration can affect the microbiological and chemical stability of the product. Good manufacturing practices (GMP) and hygiene standards: Research has examined the implementation of GMP and hygiene practices in chili sauce production facilities. This includes assessing the cleanliness of processing equipment, hygiene training for workers, and compliance with sanitary regulations.

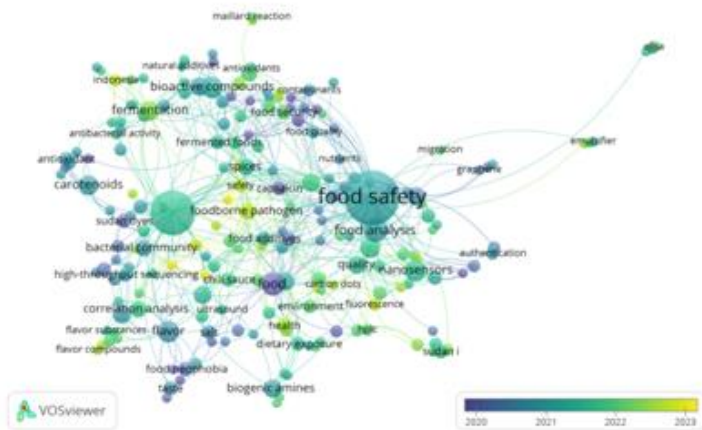


Figure 3. Keyword Co-Occurrence Overlay with A Time Frame: Food Safety of Chili Sauce

This research plays a role in the addressed topic by explaining the theoretical and methodological framework that can be applied in a broad context. Specifically, the main findings of this study demonstrate the epistemological discourse of using bibliometric analysis by considering publication trends and influential papers. It also considers how researchers build knowledge upon each other through the co-citation network of influential papers, and how knowledge evolves using the keyword co-occurrence network and overlay. In addition to discussing scholarly aspects, this study also incorporates managerial issues.

Publication trends reveal significant fluctuations between 2019 and 2023, with the highest number of publications occurring in 2021. This study applies bibliometric analysis to food safety issues in chili sauce by analyzing the most influential keywords. Detailed scientific aspects of this topic can be accessed through the publication trends section, while the co-occurrence network and overlay of keywords demonstrate the interconnections between food safety in chili sauce products that are circulating.

CONCLUSION

The results revealed nine distinct clusters encompassing aspects such as microbiological safety, chemical contaminants, allergenic substances, quality and shelf-life, and good manufacturing practices. Publication trends exhibited significant fluctuations, reaching a peak in 2021. By identifying the most popular and influential keywords, this research provides a better understanding of the relevant research focus. Furthermore, the analysis of keyword co-occurrence network and overlay showcases the relationships and interactions among various aspects of food safety in chili sauce. This information can be utilized to develop risk control strategies, and food safety standards, and enhance the overall quality and safety of chili sauce. Thus, this study contributes significantly to expanding the understanding of food safety in chili sauce and lays the foundation for further developments in this field.

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