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The Global Research Landscape of Rendang: A Bibliometric Insight into Culinary Heritage and Innovation

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ABSTRACT

Rendang, a traditional Indonesian dish, has garnered international attention for its rich flavor and cultural significance. The study aimed to analyze the global research trends related to Rendang using bibliometric methods. By examining publications, citation patterns, and key areas of focus, we aim to provide insights into the scientific community's interest and the development of research on Rendang. The analysis utilized data from major academic databases, scopus.com. The search query keyword used was "Rendang" without restrictions on language, document type, or field of study. Visualization tools utilized include VOSviewer (version 1.16.18), and RStudio (Biblioshiny). A total of 63 documents were analyzed, revealing an annual growth rate of 3.06% and an average of 11.24 citations per document, with an international co-authorship rate of 9.524%. Indonesia and Malaysia emerged as the top-cited countries. The study recommends broadening Rendang research beyond descriptive studies to explore innovations in food processing, faster cooking methods, packaging, preservation, and health impacts. Further research should address sustainability, economic impacts, and increased international collaboration, aiming for more publications in high-impact journals. Additionally, the commercialization of ready-to-eat Rendang that preserves its traditional taste and the application of smart food technologies are essential for enhancing global research impact.

Keywords: Bibliometric Analysis, Food Systems, Rendang, Indonesian Cuisine.

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INTRODUCTION

Rendang is a top-notch Indonesian meal. Rendang is a typical Minangkabau dish that comes from West Sumatra, Indonesia[1,2]. An integral aspect of Minangkabau culture, rendang embodies the identity, beliefs, and traditions of the Minangkabau people[3]. In the early 2nd century CE, Indian merchants transported their traditional cuisine to Indonesia, where the Indigenous Minang people transformed it into gulai. Rendang was made by cooking this gulai until it thickened, after which it was further boiled into kalio. Rendang became famous in Malaysia, Southeast Asia, and the rest of the globe in the 1900s when it was brought there by Indonesians, especially the Minangkabau people[4]. Rendang was named the most mouth-watering dish on Earth in two separate online polls run by Cable News Network (CNN) in 2011 and 2017[3-9].

Rendang is always served in traditional Minangkabau restaurants throughout Indonesia, and it has become a popular meal during Eid al-Fitr and a staple on Indonesian menus[9,10]. Rendang is created with a variety of ingredients, including beef, coconut milk, spices, and herbs[6]. Rendang is cooked over firewood for 6-7 hours at a temperature of ±90 °C until the meat is tender and supple, turning brown or black with a distinct scent and flavor[11]. The cooking method consists of four stages: gulai, kalio, wet rendang, and dry rendang. The finished result might be wet or dry rendang, depending on the cooking duration and nutritional value (particularly moisture content)[6,12,13]. Rendang is distinguished by its savory aroma and flavor, as well as a blend of salty, somewhat sweet, and spicy flavors[13].

Originally, rendang was mostly prepared using beef due to its plentiful supply in West Sumatra, Indonesia. However, as time passed, rendang evolved to include components beyond beef. Currently, various types of rendang are available, such as chicken rendang, lung rendang, eel rendang, oyster mushroom rendang, local rendang, egg rendang, tuna rendang, pensi rendang, fish rendang bilis, rendang runtiah, rendang cubadak, rendang tumbuak, rendang anchovies, rendang wood leaves, rendang jariang, rendang itik, rendang yam, rendang rebon, rendang baluik, rendang liver, rendang limpo, rendang oyster, rendang ikan tongkol, rendang fern, rendang grasshopper, smoked fish rendang, rubber seed rendang, and jackfruit rendang. This has the potential to enhance dietary diversification, expand the range of rendang varieties, improve the nutritional content, and optimize the economic worth of other rendang components apart than beef[3,13-20]. A distinct flavor and fragrance characterize each variety of rendang, resulting from the specific raw ingredients and spices employed. Indeed, variations in culinary techniques and the incorporation of alternative spices in each locality result in rendang possessing a unique fragrance and flavor exclusive to each region in West Sumatra, Indonesia[13].

Various processing techniques used in rendang manufacture affect its sensory attributes, such as flavor and fragrance. The selection of spices and cooking techniques results in individual variations in the volatile chemicals generated by each rendang[20]. Rendang has a moisture content of roughly 30%, making it a viable method for meat preservation[15]. The protracted process of cooking rendang will exert both beneficial and detrimental effects on the

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resulting changes. Positive modifications encompass an augmentation in the nutritional composition, an enhancement in the digestibility of proteins, and a reduction in the presence of anti-nutritional compounds in the raw materials. Notable adverse effects include a reduction in nutritional constituents due to their susceptibility to heat, oxygen, pH, light, and their combination. Changes in the nutritional composition of rendang sometimes manifest in variations in the levels of protein, fat, and carbohydrates. This is because the fundamental components for preparing rendang are meat and coconut milk. Both are abundant in lipids and proteins that can experience physical and chemical molecular alterations during the processing procedure. The observed modifications encompass protein denaturation, deamination, desulfurization, hydrolysis, dissemination, amino acid derivation, enzyme inactivation (specifically lipase, protease, amylase, lip-oxygenase, oxidative enzymes, and hydrolysis enzymes), cross-linking, and alterations in color. Furthermore, the Maillard reaction is a chemical process that occurs when amino acids (proteins) mix with reducing sugars (carbohydrates) or carbonyl components and react with aldehydes (products of fat oxidation). This Maillard reaction will impact sensory attributes including taste, fragrance, texture, and color, resulting in reduced protein digestibility by damaging two crucial amino acids (lysine and cysteine)[1].

The use of spices in rendang results in a comparatively extended shelf life for the dish. The antibacterial potency of spices such as shallots, garlic, red chilies, ginger, turmeric, and galangal has been established[6]. To enhance the sensory characteristics of rendang, several researchers have implemented alterations, such as including different thickening components (e.g. sago starch, tapioca flour, modified corn flour, xanthan gum, and carboxymethyl cellulose gum), to alter the texture to appeal to the older population[4]. It is imperative to execute the rendang processing procedure accurately to avoid cross-contamination. In addition to that, inadequate storage will lead to foodborne illness for discerning fans of rendang meat[21].

In the past, rendang was usually kept fresh by wrapping it in a piece of paper and eating it with your hands. Travelers would bring it with them as food because it lasted a long time. Now, many rendangs come in better packaging to make them last longer. For example, they come in plastic boxes[22], double plastic (one plastic for the rendang and a second plastic pouch that is labeled and makes the rendang last longer), and retort pouches, which are very popular right now. Because it is easier to use and better for the environment, and adding a sterilization process will make the food last longer[23], improved retort can packaging (lasts up to 6 months)[14], and vacuum packaging using the Arrhenius method at 25° (can last 613 days)[15]. In addition to using the right packing, you can also make rendang last longer by irradiating it[24] and adding antioxidants, like mangosteen extract[25].

Agribusiness items like rendang need particular marketing tactics since they are fragile. Product, promotion, place, and pricing are crucial to consumer loyalty, satisfaction, and retention in a great marketing plan. This helps find marketing and export opportunities[26]. Rendang marketing was once limited to souvenir shops in West Sumatra, but in the digital age, it has spread across Indonesia and beyond via social media like WhatsApp, Facebook, Instagram, e-commerce, and websites[27]. Developing a systematic approach to calculating rendang meat inventory can reduce inventory expenses (including purchasing, ordering, storing, expiration, stock shortages, and meat expiration)[28]. For example, to increase the competitiveness of processed oyster mushroom rendang products, process standards have been set to maintain quality, the selling value has been determined (not too high), a trademark/label has been created to differentiate from competitors, interesting packaging has been used, and product promotions have been conducted by spreading information around sales.

Further investigation is necessary to obtain comprehensive knowledge about rendang, necessitating the collection of further data from existing studies. Therefore, conducting bibliometric analyses on precise databases will reveal patterns and trends in scientific research worldwide[29]. Bibliometric studies facilitate the analytical examination of scientific publications, including journal articles, books, and conference proceedings, using quantitative methods to chart patterns, partnerships, and the influence of research on a specific subject. Bibliometric analysis in the rendang setting can unveil several significant features: 1) Analysis of publication patterns in rendang research, encompassing yearly production, subject matter emphasis, and geographic dispersion of authors, 2) Examination of collaboration networks among scholars and institutions engaged in rendang studies, 3) Evaluation of the influence of rendang-related research, using metrics such as citation count, journal reputation, and distribution reach, 4) Internationalization of rendang research: investigating the study and publication of this Indonesian culinary heritage beyond its country of origin. Through the use of bibliometric analysis, this research seeks to offer fresh perspectives on the evolution of knowledge and comprehension of rendang throughout the worldwide academic community. This paper will elucidate the manner in which rendang, as a gastronomic legacy, has exerted influence and engaged with scientists and academics across several fields of study.

METHODS

Data Collection

Information gathering was conducted by utilising sophisticated search parameters in Scopus-indexed journals using the phrase "Rendang". It is possible to narrow down the search to include only the abstract, title, and keywords of the article. This study encompasses studies undertaken from 2001 until 2024. Furthermore, a limitation was implemented to exclusively list finished papers that are in the publishing stage. Collection of data took place on 10 July 2024. Any modifications made subsequent to that date were not taken into account in this review. In Figure 1, a comprehensive summary of the gathered data is shown, comprising 63 papers from 37 sources.

Bibliometric Analysis

The data set was obtained and transferred to an open refine (version 3.6.1) application for data refinement. The bibliometric analysis was then completed using Vos Viewer (version 1.16.18), tableau, and Rstudio (bibliometrics). The findings were then presented as figures and tables. The flow chart process of this review is depicted in Figure 2.

RESULTS AND DISCUSSION

General Performances of Selected Publications in The Research Field

A bibliometric analysis reveals that the majority of Scopus documents on rendang are derived from article sources, accounting for 55.6%, 36.5% from conference papers, 4.8% from reviews, 1.6% from Book Chapters, and 1.6% or 1 document from a conference review (Figure 3 and Table 1). The current state of study on Rendang on Scopus is somewhat restricted. However, it is evident that while articles

Table 1. Document types of rendang

No	Document Type	Documents
1	Article	35
2	Conference paper	23
3	Review	3
4	Book chapter	1
5	Conference review	1

Figure 1. Main information of the collected documents was obtained on bibliometric software.

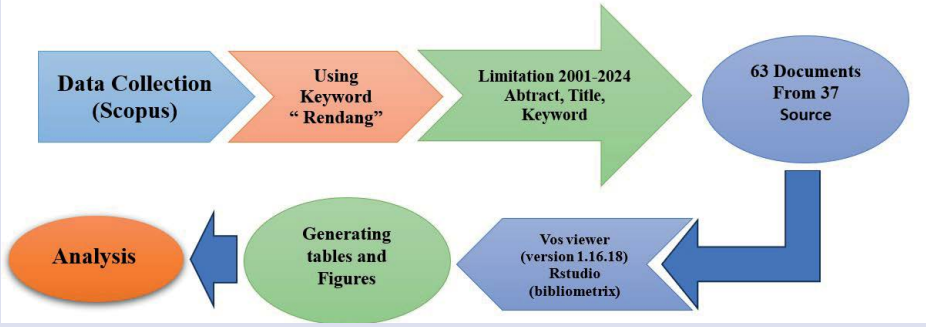

Figure 2. Flowchart of bibliometric analysis.

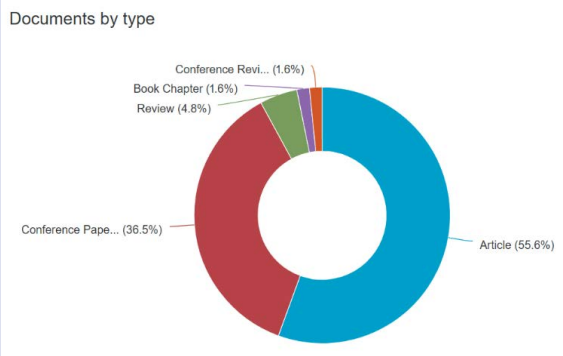

Figure 3. Percentage of document types of "Rendang" publication.

constitute the majority of the documents, conference papers also contribute significantly to the number of document kinds. The scarcity of documentation may be attributed to various factors, one of which being the fact that rendang is a traditional Indonesian meal with distinct features and cultural background. Consequently, it may be seen as a niche or specialized topic that fails to capture broad scholarly interest. Furthermore, the study on particular traditional foods lacks comprehensive coverage of several research domains as it is confined to dimensions of the culinary procedure, nutritional composition, or cultural preservation[30,31]. A significant number of rendang-related articles are still published in journals that are not included in the Scopus index, resulting in a decrease in the quantity of literature documented in global databases. Promoting collaboration between researchers in Rendang and prominent researchers in other countries could enhance the quality, visibility, and influence of research pertaining to Rendang[32].

The production of Rendang publications in Scopus between 2001 and 2024 is depicted in Figure 4. The first Rendang articles were published on Scopus in 2001; after that, no publications were made until 2010. There was a noticeable increase in the number of papers published on Scopus beginning in 2011. constant from 2015 to 2024. In 2023, document productivity will reach its peak, producing 10 papers annually. Six documents have been published on Scopus as of July 2024, thus it's highly probable that more will be added before the year is over. The amount of document citations in Scopus documents per year is displayed in Figure 5. Three peaks comprise the maximum number of citations: the most in 2011, the highest in 2016, and the highest in 2021 (Figure 5). Since there were no rendang publications in Scopus documents between 2002 and 2010, the citation value was likewise 0.

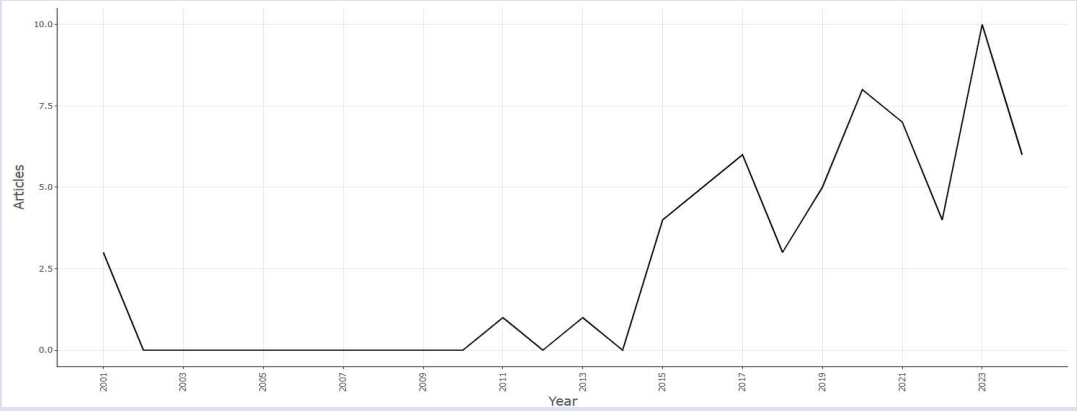

Figure 4. Annual Scientific Production.

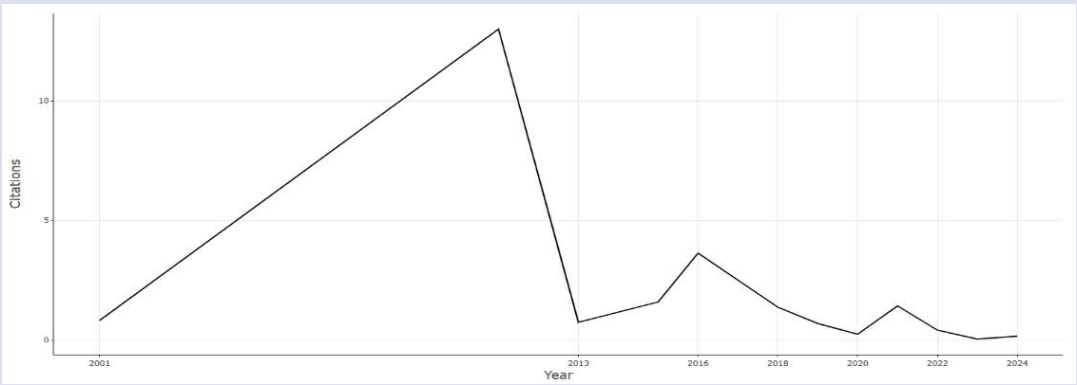

Figure 5. Average citations per year.

Most Relevant Sources and Affiliations

Figure 6 indicates that conference proceedings, specifically the IOP Conference Series: Earth and Environmental Science (12 papers) and AIP Conference Proceedings (5 documents), continue to be the primary publication sources on the rendang issue. The scope of research on rendang in Scopus papers is currently restricted to descriptive, exploratory investigations, or case studies. The primary avenue for publication in scientific meetings or conference series remains the most promising. However, in order to be eligible for publication in scientific journals that are structured around articles, it is often necessary to use a more formal methodology or approach that relies on quantitative data. This presents a valuable opportunity for researchers to apply experimental research in order to develop innovative rendang goods that address the limitations of rendang products. These limitations include issues related to cooking time, complexity of spices, cost of spices, and package optimization (11). Records indicate that starting in 2011, a number of papers were published in Scientific Journals such as the Journal of Ethnic Foods (n=5), the International Journal on Advanced Science, Engineering, and Information Technology (n=4), and Animal Feed Science and Technology (n=2).

The Journal of Ethnic Food centres its attention on the distinctive and customary culinary practices originating from many cultures across the globe. This publication offers a comprehensive analysis of the correlation between diet and the overall well-being and health of individuals. A rendang-related article published in this journal is titled "Rendang lokan: history, symbol of cultural identity, and food adaptation of the Minangkabau tribe in West Sumatra"[8].

This article explores the distinctiveness of rendang in West Sumatra, which is not only prepared with muscle meat but also incorporates additional components such as oysters (sea cucumber). From the analysis presented in this article, it can be inferred that rendang lokan exemplifies the properties of the Minangkabau people, namely their ability to adjust to environmental circumstances while preserving their cultural heritage. This paper serves as a potential source of inspiration and ideas for other researchers interested in publishing articles in the Journal of Ethnic Food. Specifically, it explores various types of rendang commonly found in West Sumatra, such as chicken rendang, wooden rendang, egg rendang, eel rendang, jengkol rendang, rendang duck, rendang pensi, rendang fern, and others[33,34].

A more comprehensive discussion of the rendang topic in terms of processing technology may be found in the International Journal on Advanced Science, Engineering, and Information Technology. The two published papers are named "Chemical Characterization and Fatty Acid Composition in Rendang Minangkabau"[35] and "The Impact of Repeated Heating on the Fatty Acid Composition of beef and Spices in Rendang"[36]. Additional sources pertaining to the subject of rendang include as follows: IOP Conference Series: Materials Science and Engineering, Journal of the Science of Food and Agriculture, Pakistan Journal of Nutrition, 14th International Conference on Advances in Computer, and Advances in Animal and Veterinary Sciences.

The curve shown in Figure 7 illustrates the quantity of articles originating from different affiliates. In terms of culinary issues, Universiti Putra Malaysia holds the leading position with 33 publications that demonstrate significant contributions, particularly in the area of rendang. Rendang and its evolution are integral components of Malay culture. Malaysia and Indonesia, being contiguous Malay regions, share a common cultural heritage. Additionally, the activities of Minang

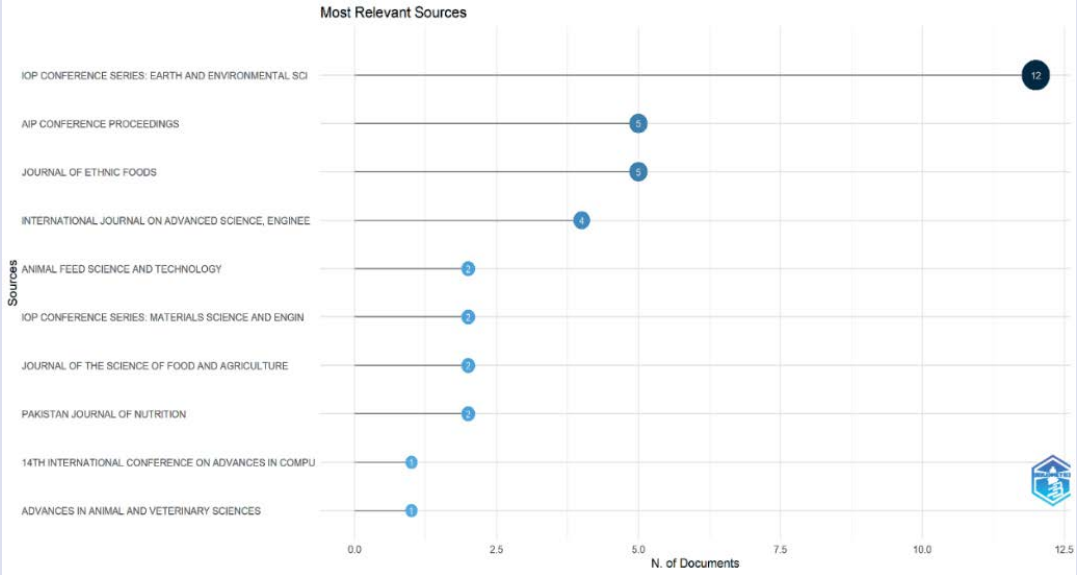

Figure 6. The top 10 sources for publication in the field of rendang.

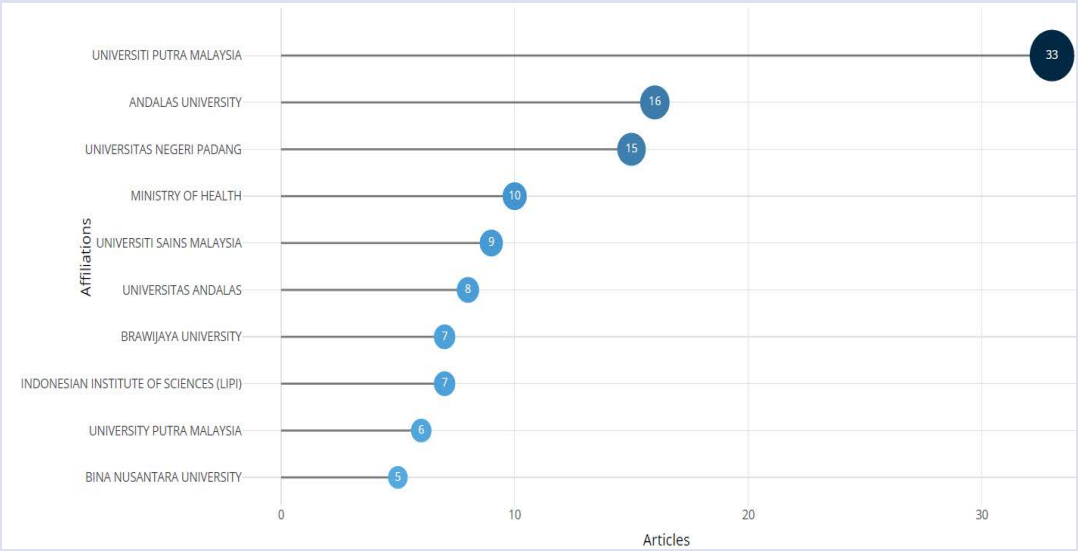

Figure 7. Top 10 most relevant affiliations.

Table 2. The top 10 most productive countries in the field of Rendang research

No	Country	Freq
1	INDONESIA	181
2	MALAYSIA	99
3	AUSTRALIA	4
4	INDIA	2
5	JAPAN	2
6	THAILAND	2
7	UK	1

Table 3. The top most cited countries in the field of Rendang research.

Country	TC	Average Article Citations
MALAYSIA	476	31.70
INDONESIA	82	2.90

traders who migrated from Sumatra to Malacca have contributed to the transmission of Minang traditions. Therefore, it is not unexpected that Rendang is also a popular food among the Malaysian population and has been extensively researched by scholars.

Furthermore, this may also suggest that UPM possesses a robust research program and ample resources to engage in scholarly publications on rendang subjects. In general, Malaysia also has a well-organized research management system. Nevertheless, Indonesian universities and institutes also have a substantial impact on research and publications pertaining to this rendang subject. Andalas University has published 16 publications, Padang State University has contributed 15 articles, the Ministry of Health has contributed 10 articles, Andalas University under a different name has provided 8 articles, Brawijaya University and the Indonesian Institute of Sciences (LIPI) have each contributed 7 articles.

Analysis of Country/Region

Table 3 displays the countries that have reported the highest productivity in research on Rendang. Indonesia has the leading position with 181 publications, followed by Malaysia with 99 publications. Australia ranks third with 4 publications, followed by India, Japan, and Thailand each with 2 publications, with the UK rounding out the list with 1 publication. Nevertheless, the level of national output does not provide a clear correlation with the quantity of country citations. In fact, the number of citations for papers generated by Malaysia surpasses that of documents coming from Indonesia (Table 3).

Table 3 presents a comparison of the total citations (TC) and average article citations between Malaysia and Indonesia. The average number of citations per article in Malaysia is 31.80, with a total of 477, whereas in Indonesia it is 2.90, with a total of 82. These findings indicate that research contributions from Malaysia on Rendang obtained a higher number of citations compared to research contributions from Indonesia. This provides a comprehensive summary of the scientific contributions from different countries on this subject. Countries that have a significant number of citations can be attributed to several factors. These include the publication of articles in reputable journals with a high impact factor. Additionally, robust international collaboration can contribute to increased citation rates of an article by researchers in different countries[37,38].

The provided figure depicts a network map illustrating the research collaboration on rendang among multiple countries. Evidently, Indonesia and Malaysia serve as the primary centers in this network, with Indonesia establishing robust links with Japan, the UK, and Vietnam, while Malaysia is linked to Australia, Thailand, and India. This network delineates the collaborative efforts of several nations in rendang research, with Indonesia and Malaysia serving as the primary hubs linking these countries within the research network. Specifically, Figure 9 demonstrates that Indonesia and Malaysia have the highest production in rendang theme articles, indicated by the color dark blue.

Author Contributions

The graph in Figure 11 illustrates the impact of the top 10 writers with the greatest h-index in Rendang research. Each data point on the graph corresponds to one author and their h-index value, which quantifies the scientific influence of their work. Achieving the highest h-index are Abdullah N and Ho Yw, both scoring 7, followed by Sieo Cc at 6, and Saminathan M at 5. The h-index of the four writers indicated previous is consistent with the level of production shown in the paper. Produced (Figure 12). The h-index is a quantitative measure that assesses the productivity and influence of an author's writings by taking into account the quantity of published articles and the number of citations received for those works[39]. The h-index of Gan Hm and Wong Cmvl is 4, whereas Liang Jb and Tan Hy have a h-index of 3. Within this graph, Ariffin F and Huang Xd have the lowest h-index, which is measured at 2. This graph visually illustrates the relative scientific knowledge contributions of each author listed. Authors which have a high h-index are acknowledged as significant contributors to their respective discipline.

Table 4. Most productive authors

Authors	Articles	Articles Fractionalized
ABDULLAH N	7	1.09
HO YW	7	1.09
SIEO CC	6	0.95
SAMINATHAN M	5	0.76
GAN HM	4	0.56
KUSUMANINGRUM A	4	0.60
NURHIKMAT A	4	0.60
PRAHARASTI AS	4	0.60

Figure 8. Co-occurrence network of countries.

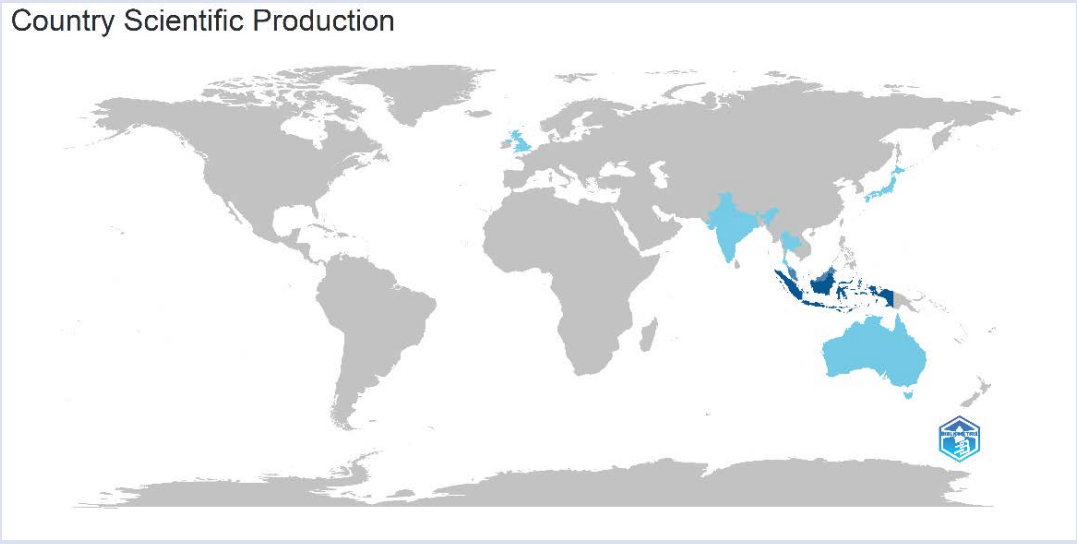

Figure 9. Countries. Scientific Production.

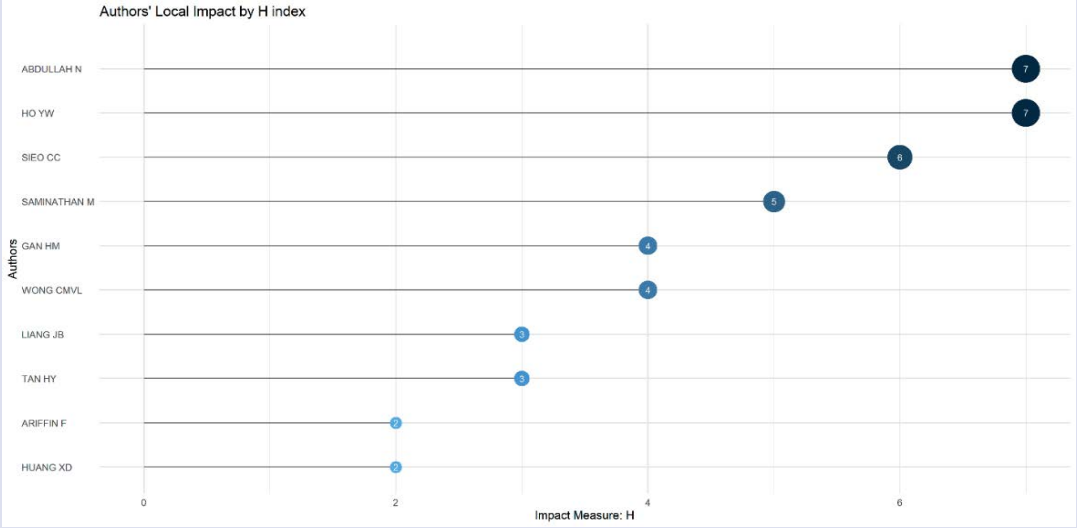

Figure 10. List author with the highest number of citations in the field of Rendang research.

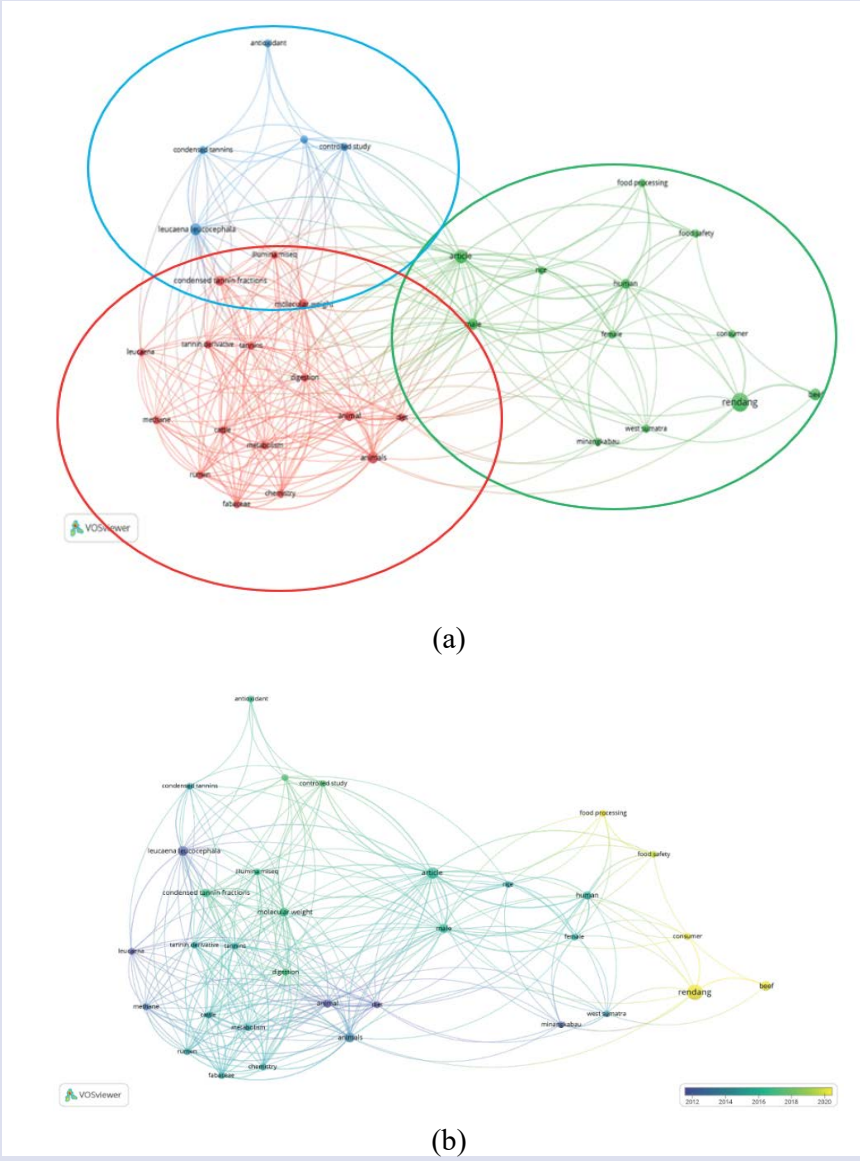

Figure 11. (a) Cluster of keywords from the study of rendang, (b) Cluster maps of keywords of rendang between 2012-2024.

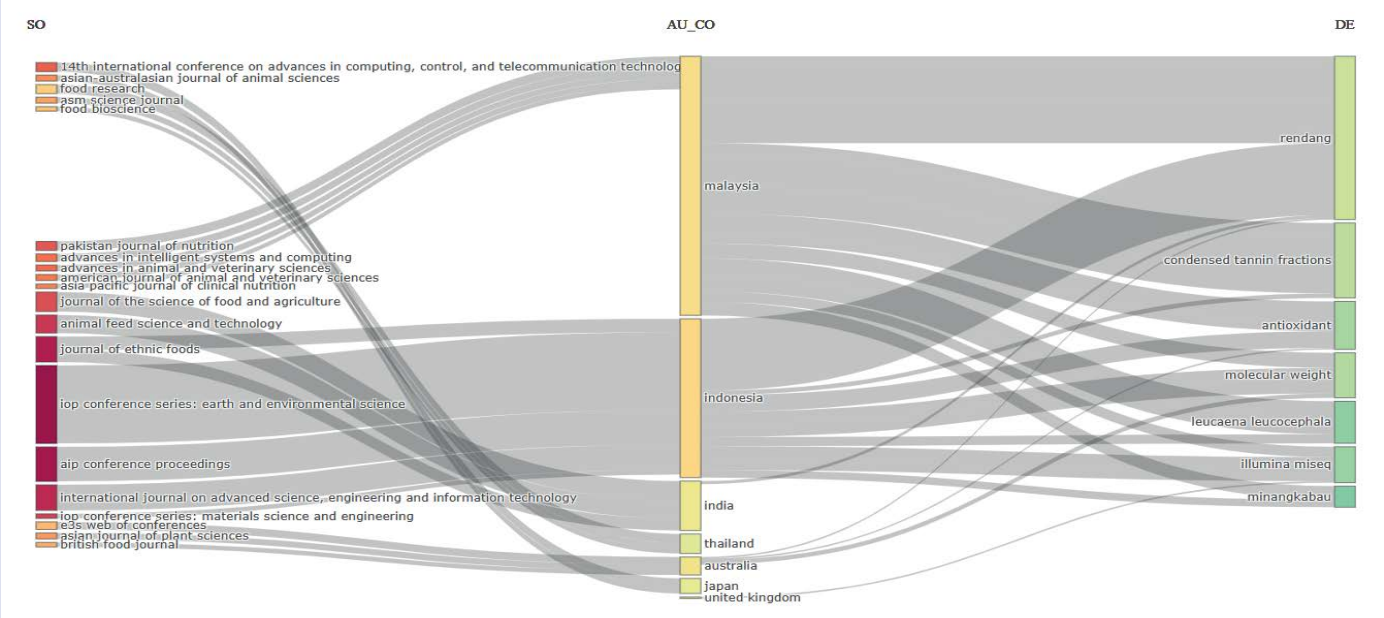

Figure 12. Three Plot Fields Diagram.

Table 5. Most cited documents

Paper	Title	Total Citations	TC per Year	Normalized TC
Tan hy, 2011, anim feed sci technol	Effects of condensed tannins from Leucaena on methane production, rumen fermentation and populations of methanogens and protozoa in vitro	182	13.00	1.00
Abu zarin m, 2016, food sci hum wellness	Antioxidant, antimicrobial and cytotoxic potential of condensed tannins from Leucaena leucocephala hybrid-Rendang	85	9.44	2.59
Raji mna, 2017, j ethnic food	Past and present practices of the Malay food heritage and culture in Malaysia	66	8.25	3.27
Saminathan m, 2016, anim feed sci technol	Effects of condensed tannin fractions of different molecular weights on population and diversity of bovine rumen methanogenic archaea in vitro , as determined by high-throughput sequencing	43	4.78	1.31
Lipoeto ni, 2001, asia pac j clin nutr	Contemporary Minangkabau food culture in West Sumatra, Indonesia	41	1.71	2.05
Saminathan m, 2015, j sci food agric	Effects of condensed tannin fractions of different molecular weights from a *Leucaena leucocephala* hybrid on in vitro methane production and rumen fermentation	38	3.80	2.38
Nurmufida m, 2017, j ethnic food	Rendang: The treasure of Minangkabau	29	3.63	1.44
Saminathan m, 2016, j sci food agric	Modulatory effects of condensed tannin fractions of different molecular weights from a Leucaena leucocephala hybrid on the bovine rumen bacterial community in vitro	23	2.56	0.70
Melia s, 2015, pak j nutr	Antioxidant and Antimicrobial Activities of Gambir (*Uncaria gambir* Roxb) Extracts and Their Application in Rendang	20	2.00	1.25
Khamseekhiew b, 2001, asian-australas j anim sci	Ruminal and Intestinal Digestibility of Some Tropical Legume Forages	19	0.79	0.95

Table 6. Cluster of keywords analysis obtained on Bibliometrix software.

Cluster	Number of items	Keywords on VOSviewer network
1	16	Animal, animals, cattle, chemistry, condensed tannin, diet, digestion, fabcae, metabolism, methane, molecular weight, rumen, tannin derivative, tannins
2	12	Article, beef, consumer, female, food processing, food safety, human, male, Minangkabau, rendang, rice, west sumatra
3	5	Beef, convolution, image recognition, kalio, learning system, Malaysia, antioxidant

The Most Cited Documents

The most cited document is the article entitled "*Effects of condensed tannins from Leucaena on methane production, rumen fermentation and populations of methanogens and protozoa in vitro*"[40] with 182 citations published in the Journal Animal Feed Science. Another article is entitled "*Antioxidant, antimicrobial and cytotoxic potential of condensed tannins from Leucaena leucocephala hybrid-Rendang*"[41] which was published in Food Science and Human Wellness. These two articles discuss the use of condensed tannin extracted from *Leucaena leucocephala* Hybrid-Rendang (LLR). The third most cited document entitled "*Past and present practices of the Malay food heritage and culture in Malaysia*" was published in the Journal of Ethnic Foods, and was cited 66 times. This article highlights regional Malay foods in Malaysia from ancient times to the present including rendang[42]. This article is not only cited in studies related to food but also other interdisciplinary studies such as anthropology, sociology, history and others. Interdisciplinary studies tend to increase the citation rate of a publication, because they can create breakthroughs and new innovations[43].

High Appearance Keywords Used in The Research Field

There are 22 keywords that the authors use the most frequently, with at least two co-occurrences. We looked at keywords that appeared at least twice in the last decade and found 22 met the requirement, which can be divided into 3 clusters (Table 5). As shown in Figure 12a, each circle represents a keyword, the size of the circle indicates the frequency of the keyword, the line between the circles indicates that they appear together in a publication, and different colors indicate different clusters. The red cluster or cluster 1 is more related to keywords related to techniques such as "chemistry", "digestion", "metabolism" and "rumen". This cluster may refer to rendang research which can focus on certain chemical and biochemical aspects both related to processing and its effects on health.

The green cluster or cluster 2 shows the keywords "food safety", "consumer", "food processing", "beef", "Minangkabau" and others. These keywords are related to consumption analysis, food safety, and consumer perceptions of rendang. Furthermore, this research may also pertain to the rendang processing procedure and traditional or cultural elements associated with rendang. Furthermore, the third cluster contains phrases such as "antioxidant", "controlled study", and "controlled tannin", which specifically pertain to controlled research and the antioxidant characteristics of rendang. These studies emphasize the significance of researchers in investigating the health attributes of rendang or the constituents employed in its preparation. Overall, this network demonstrates the interconnections between different elements of rendang-related study and highlights the wide range of subjects investigated.

From this bibliometric analysis, it is evident that there have been distinct changes in research emphasis between 2012 and 2024 (Figure 12b). The dark blue spectrum represents terms that emerged at the start of the research year, particularly around 2012, while the yellow spectrum represents the most recent study focal point, namely around 2020. The initial phase of the study primarily examined biological characteristics, namely the chemical properties of materials, in Scopus publications. By 2014-2016, research started to achieve a harmonious equilibrium between chemical factors and wider considerations such as food safety and customer welfare. Conversely, in recent years, study have mostly concentrated on investigating the correlation between rendang, beef, and food processing, and this has also been associated with customer attitudes.

The paper titled "*Application of Life Cycle Assessment on Processing of Beef Rendang Products Using Steam Cauldron Technology*"[44] was published in 2024 and focuses on food processing. This paper examines the life cycle analysis of rendang production and the environmental effect assessment of rendang, encompassing areas such as transportation, storage, washing, milling, and packing. This study offers suggestions for enhancing the environmental sustainability of rendang production, specifically by implementing a Beef Freeze system for storing rendang spices, therefore minimizing electricity consumption. These study patterns might offer scholars valuable directions to investigate unexplored aspects pertaining to the subject of rendang..

Three Plot Fields

In bibliometric analysis, three plot fields are graphical representations that depict the correlation among three individual components. The three components elaborated in this research are SO (Source, namely the conference journal), AU-CO (Country of Author, namely the author's country of origin), and DE (Descriptor or primary keywords utilized in the work. The analysis of Figure 13 reveals that rendang-related subjects have been extensively explored in different regions of Malaysia and Indonesia. The study focused on articles pertaining to specific keywords such as "rendang", "condensed tannin fractions", "antioxidant", "molecular weight", "*Leucana leucochepala*", and "minangkabau". This figure indicates that Indonesian authors publish a greater number of Scopus indexed papers in scientific conferences compared to Scientific Journals. Concurrently, the quantity of scholarly papers arising from foreign nations, pertaining to rendang subjects, remains quite limited.

CONCLUSION

This bibliometric analysis discusses the development of research trends with rendang from 2012 to 2024. However, the progress of rendang research in Scopus publications remains quite restricted, but there are still prospects to enhance productivity on an annual basis. The peak number of publications is projected to take place in 2023, exacting 10 documents annually. The majority of documents that address rendang are of the article-type form. The IOP conference series on earth and environmental science has garnered the highest number of published sources, with 12 papers. The countries of Malaysia and Indonesia exhibit the highest levels of document output and engage in the most amount of international collaboration. Malaysia also has the distinction of having the most citations. The most often referenced scholarly work is an article that emphasizes the evolution of traditional Malay cuisine in Malaysia. The recommendation from this bibliometric study is to expand rendang research from descriptive and exploratory studies towards innovation, such as food processing technology, especially to speed up the rendang cooking process, packaging, preservation and health impacts. In addition, diversification of topics is needed, including sustainability of raw materials and economic impact. Increasing international collaboration and publication productivity in reputable journals is also important to expand the scope of research. More applicable research in industry, such as the commercialization of rendang as a ready-to-eat product that still maintains the original taste of rendang and the use of smart food technology, is also recommended so that this research will have an increasingly global impact.

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REFERENCES

1. Rini, F. Azima, K. Sayuti, and Novelina, "The Evaluation of Nutritional Value of Rendang Minangkabau," *Agric. Agric. Sci. Procedia 9*, vol. 1, no. 1, pp. 335 – 341, 2016.

2. B. Budiyanto, U. Anis, I. Jayadi, and S. Syafnil, "The Quality of Lokan (Geloina erosa) Rendang Oil Substituted with Red Palm Oil Olein," *Indones. FOOD Sci. Technol. J.*, vol. 7, no. 1, pp. 17–22, 2023.
3. Rusdi, B. Saputra, Wirdanengsih, Erianjoni, E. Hardi, and Firza, "Diversification of rendang daun kayu: Strengthening the food security of the Minangkabau community," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 1323, no. 1, pp. 1–7, 2024.
4. N. A. Zarim, S. Z. Abidin, and F. Ariffin, "Shelf life stability and quality study of texture-modified chicken rendang using xanthan gum as thickener for the consumption of the elderly with dysphagia," *Food Biosci.*, vol. 42, no. 1, pp. 1–10, 2021.
5. M. Nurmufida, G. H. Wangrimen, R. Reinalta, and K. Leonardi, "Rendang: The treasure of Minangkabau," *J. Ethn. Foods*, vol. 4, no. 4, pp. 232–235, 2017, doi: 10.1016/j.jef.2017.10.005.
6. Wellyalina, F. Azima, A. Asben, and D. Syukri, "Determination of Phytochemical Compound And Antimicrobial Activities of Rendang Spices," *Asian J. Plant Sci.*, vol. 22, no. 4, pp. 675–684, 2023.
7. W. Sartika, H. Utami, L. Radiati, and B. Hartono, "Dynamic Model Of Beef Availability For Rendang Industry In Payakumbuh City," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 888, no. 1, pp. 1–7, 2021.
8. S. Fatimah, D. Syafrini, Wasino, and R. Zainul, "Rendang lokan: history, symbol of cultural identity, and food adaptation of Minangkabau tribe in West Sumatra, Indonesia," *J. Ethn. Foods*, vol. 8, no. 12, pp. 1–10, 2021.
9. F. Rahman, "Tracing the origins of rendang and its development," *J. Ethn. Foods*, vol. 7, no. 28, pp. 1–11, 2020.
10. N. Ismail, M. S. A. Karim, F. A. C. Ishak, M. M. Arsyad, and S. K. and J. Sirison, "The Malay's traditional sweet, dodol: a review of the Malaysia's heritage delicacy alongside with the rendition of neighbouring countries," *J. Ethn. Foods*, vol. 8, no. 19, pp. 1–13, 2021.
11. H. Parbuntari, F. Azra, P. K. Hamzah, F. Amelia, I. P. Dewi, and Mahmud, "Chemical analysis and consumer acceptance of oyster mushroom (Pleurotus ostreatus) rendang as a typical West Sumatra culinary innovation," *Futur. Food J. Food, Agric. Soc.*, vol. 11, no. 4, pp. 1–14, 2023.
12. A. Faridah and R. Holinesti, "Evaluation of Nutritional Content of Beef Rendang Using Wet and Dry Seasonings," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 810, no. 1, pp. 1–6, 2021.
13. A. Suresti, R. Wati, U. Gatot, and A. Hasan, "Analysis of Added Value of Various Rendang Products in Strengthening Regional Innovation System in the City of Payakumbuh, West Sumatera," *Am. J. Anim. Vet. Sci.*, vol. 16, no. 4, pp. 312–317, 2021.
14. N. A. Zarim, Z. A. Syahariza, F. Ariffin, and N. A. Wahab, "A Sensory Study on the Effect of Different Thickeners in Texture-Modified Chicken Rendang," *ASM Sci. J.*, vol. 18, no. 1, pp. 1–13, 2023.
15. R. Fiana and W. Murtius, "Estimating the Shelf Life of Oyster Mushroom Rendang packed with Vacuum or Non-Vacuum technique by the Application of the Arrhenius Methods," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 1059, no. 1, pp. 1–7, 2022.
16. A. Nadra Khairat and E. Nora, "Rendang Lokan As Culinary Tourism Attraction In Pesisir Selatan," *J. Bussines Hosp. Tour.*, vol. 6, no. 2, pp. 401–407, 2020.
17. Nurjanah, S. H. Suseno, N. Andika, T. Hidayat, L. P. Manalu, and H. Adinegoro, "Determination of coconut milk's volume to produce rendang tuna," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 1033, no. 1, pp. 1–10, 2022.
18. Suparmi *et al.*, "Diversification, Organoleptic and Chemical Quality Characteristics of Processed Products Based on Thorn Fish (Hexanematichthys sagor) Smoke," *Pharmacogn J*, vol. 13, no. 2, pp. 606–609, 2024.
19. C. Refdi, F. Rasdiana, and R. Deswita, "Characteristics of Physical, Chemical, and Organoleptic Properties of Gulai, Kalio, and Rendang from Rubber Seeds (Hevea Brasiliensis) as Traditional Plant-based Food," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 1182, no. 1, pp. 1–14, 2023.
20. D. Syukri *et al.*, "Profiling the Volatile Compound of Indonesian Rendang Using GC-MS/MS Analysis," *Online J. Biol. Sci.*, vol. 24, no. 1, pp. 95–102, 2024.
21. N. N. A. Bujang *et al.*, "Outbreak of foodborne disease in a boarding school, Negeri Sembilan state, Malaysia, 2021," *WPSAR*, vol. 14, no. 3, pp. 1–7, 2023.
22. N. H. Parnanto, R. R. A. Qonita, and E. W. Riptanti, "Meningkatkan Daya Saing Produk Olahan Rendang Jamur Tiram," *Berdikari J. Pengabdi. Masy. Indones.*, vol. 2, no. 1, pp. 24–29, 2019.
23. A. S. Praharasti *et al.*, "Estimation of Sterilization Value using General Method and Ball Formula for Beef Rendang in Retort Pouch," *Int. J. Adv. Sci. Eng. Inf. Technol.*, vol. 10, no. 5, pp. 2118–2125, 2020.
24. Z. I. Koenari *et al.*, "Potential Use of Gamma-Irradiated Ethnic Ready-to-Eat Foods to Improve the Nutritional Status of Landslide Victims," *Foods*, vol. 5, no. 53, pp. 1–10, 2016.
25. S. Melia, D. Novita, I. Juliyarsi, and E. Purwati, "The characteristics of the pericarp of garcinia mangostana (mangosteen) extract as natural antioxidants in rendang," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 287, no. 1, pp. 1–6, 2019.
26. T. Edwin, J. Hellyward, R. Wati, A. Rastosari, and Y. Utami, "The impact of marketing mix on rendang products customer loyalty in the new normal era," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 1341, no. 1, pp. 1–8, 2023.
27. A. Ramadan and A. Fatchiya, "Efektifitas Instagram Sebagai Media Promosi Produk ' Rendang UNINAM,'" *J. Sains Komun. dan Pengemb. Masy.*, vol. 5, no. 1, pp. 64–84, 2021.
28. F. G. Dendra, E. Amrina, and A. S. Indrapriyatna, "Inventory Control Model of Beef for Rendang Products," *J. Optimasi Sist. Ind.*, vol. 22, no. 1, pp. 23–30, 2023.
29. S. S. Monteiro, V. M. de Oliveira, and M. A. de B. Pasquali, "Probiotics in Citrus Fruits Products: Health Benefits and Future Trends for the Production of Functional Foods—A Bibliometric Review," *Foods*, vol. 11, no. 1299, pp. 1–15, 2022.
30. Z. Rocillo-Aquino, F. Cervantes-Escoto, J. A. Leos-Rodríguez, D. Cruz-Delgado, and A. Espinoza-Ortega, "What is a traditional food? Conceptual evolution from four dimensions," *J. Ethn. Foods*, vol. 8, no. 1, 2021, doi: 10.1186/s42779-021-00113-4.
31. D. Y. Kwon, K. Soon-Hee, K. R. Chung, J. Daily, and S. Park, "Science and philosophy of Korea traditional foods (K-food)," *J. Ethn. Foods*, vol. 10, no. 1, 2023, doi: 10.1186/s42779-023-00194-3.
32. Z. Kohus, M. Demeter, G. P. Szigeti, L. Kun, E. Lukács, and K. Czakó, "The Influence of International Collaboration on the Scientific Impact in V4 Countries," *Publications*, vol. 10, no. 4, 2022, doi: 10.3390/publications10040035.
33. M. Nurmufida, G. H. Wangrimen, R. Reinalta, and K. Leonardi, "Rendang: The treasure of Minangkabau," *J. Ethn. Foods*, vol. 4, no. 1, pp. 232–235, 2017.
34. Rusdi, B. Saputra, Wirdanengsih, Erianjoni, E. Hardi, and Firza, "Diversification of rendang daun kayu: Strengthening the food security of the Minangkabau community," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 1323, no. 1, 2024, doi: 10.1088/1755-1315/1323/1/012005.
35. F. Azima, "Chemical characteristic and fatty acid profile in rendang of minangkabau," *Int. J. Adv. Sci. Eng. Inf. Technol.*, vol. 6, no. 4, pp. 465–468, 2016.

36. R. Yenrina, D. Andhika, I. Ismed, D. Rasjmida, and P. Triyani, "The effect of repeated heating on fatty acid profile of beef and spices of rendang," *Int. J. Adv. Sci. Eng. Inf. Technol.*, vol. 5, no. 2, pp. 75–79, 2015.

37. S. Liao, C. Lavender, and H. Zhai, "Factors influencing the research impact in cancer research: a collaboration and knowledge network analysis," *Heal. Res. Policy Syst.*, vol. 22, no. 1, 2024, doi: 10.1186/s12961-024-01205-8.

38. M. J. Smith, C. Weinberger, E. M. Bruna, and S. Allesina, "The scientific impact of nations: Journal placement and citation performance," *PLoS One*, vol. 9, no. 10, pp. 1–6, 2014, doi: 10.1371/journal.pone.0109195.

39. W. E. Schreiber and D. M. Giustini, "Measuring Scientific Impact with the h-Index," *Am. J. Clin. Pathol.*, vol. 151, no. 3, pp. 286–291, 2019, doi: 10.1093/ajcp/aqy137.

40. H. Yang and J. Irudayaraj, "Comparison of near-infrared, Fourier transform-infrared, and Fourier transform-Raman methods for determining olive pomace oil adulteration in extra virgin olive oil," *J. Am. Oil Chem. Soc.*, vol. 78, pp. 889–895, 2001.

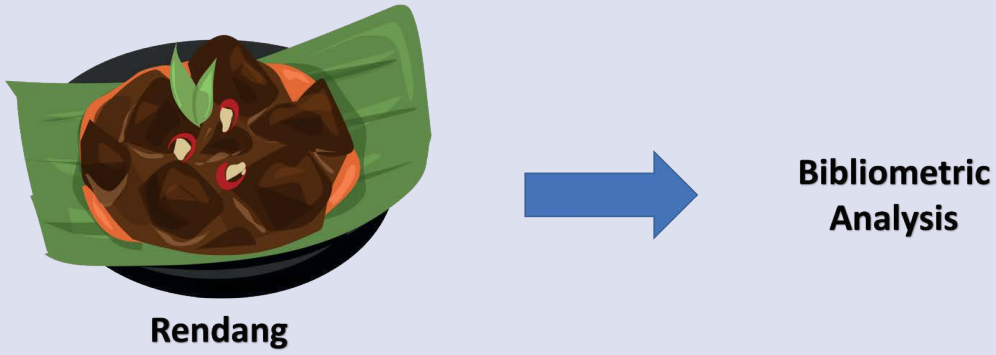
41. M. Abu Zarin, H. Y. Wan, A. Isha, and N. Armania, "Antioxidant, antimicrobial and cytotoxic potential of condensed tannins from Leucaena leucocephala hybrid-Rendang," *Food Sci. Hum. Wellness*, vol. 5, no. 2, pp. 65–75, 2016, doi: 10.1016/j.fshw.2016.02.001.

42. M. N. A. Raji, S. Ab Karim, F. A. C. Ishak, and M. M. Arshad, "Past and present practices of the Malay food heritage and culture in Malaysia," *J. Ethn. Foods*, vol. 4, no. 4, pp. 221–231, 2017, doi: 10.1016/j.jef.2017.11.001.

43. X. Cai, X. Lyu, and P. Zhou, "The relationship between interdisciplinarity and citation impact—a novel perspective on citation accumulation," *Humanit. Soc. Sci. Commun.*, vol. 10, no. 1, pp. 1–12, 2023, doi: 10.1057/s41599-023-02475-3.

44. M. F. Ridwan, R. Aziz, and R. A. Regia, "Application of Life Cycle Assessment on Processing of Beef Rendang Products Using Steam Cauldron Technology," *Ecol. Eng. Environ. Technol.*, vol. 25, no. 9, pp. 298–310, 2024, doi: 10.12912/27197050/190384.

GRAPHICAL ABSTRACT



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