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Article

Halal Authentication of Gelatin: A Bibliometric Review of FTIR Spectroscopy and PCR Techniques

Norliyana Nordin[1], Shahrina Ismail[1], Norlelawati Arifin[1], Maryam Mohamed Rehan[1] and Mohamad Azhan Yahya[2]

[1] Faculty of Science and Technology, Universiti Sains Islam Malaysia, Bandar Baru Nilai, 71800 Nilai, Negeri Sembilan, Malaysia.

[2] Faculty of Law, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor Darul Ehsan, Malaysia.

Correspondence should be addressed to:
Shahrina Ismail; shahrinaismail@usim.edu.my

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***Abstract*—This research provides an overview of a bibliometric analysis of research on halal authentication of gelatin, with particular focus on the application of Fourier Transform Infrared (FTIR) spectroscopy as well as Polymerase Chain Reaction (PCR) techniques. The analysis was conducted using 71 journal articles retrieved from the Scopus database, covering the period from 2012 to 2025. VOSviewer software was used to analyse publication trends, citation patterns, keyword co-occurrence, and international collaboration among countries. The results indicate that research activity in this field has gradually increased over time, with a notable rise in publications in recent years, reflecting growing global interest in halal verification and food authenticity. Citation analysis shows that the most influential studies primarily focus on the development of FTIR and PCR-based analytical methods for detecting and identifying gelatin sources. Keyword co-occurrence analysis reveals two dominant research themes, namely spectroscopic analysis using FTIR and molecular detection using PCR techniques. In terms of geographical contribution, Indonesia and Malaysia emerged as the leading countries in publication output. At the same time, the co-authorship network demonstrates regional collaboration primarily among countries in Asia and the Middle East. Overall, the findings highlight the increasing importance of reliable analytical methods and international collaboration in strengthening halal authentication research and supporting the development of effective halal assurance systems.**

***Keywords*— Gelatin; bibliometric; halal; FTIR; PCR**

I. INTRODUCTION

The authentication of halal products, particularly gelatin, is of paramount importance for Muslim consumers due to religious dietary restrictions. Gelatin, a protein derived from animal collagen, is widely used in food, pharmaceutical, and cosmetic products. However, the source of gelatin, whether bovine, porcine, or fish, significantly impacts its halal status. Ensuring that gelatin is free from porcine derivatives, which are considered haram (forbidden), is vital for compliance with Islamic dietary laws. This necessitates the development and application of reliable analytical methods for halal authentication. Among the various techniques available, Fourier Transform Infrared (FTIR) Spectroscopy as well as Polymerase Chain Reaction (PCR), have emerged as prominent methods for detecting and verifying the source of gelatin.

FTIR Spectroscopy has been widely utilized for gelatin authentication due to its ability to provide detailed molecular fingerprints. This technique, particularly when combined with Attenuated Total Reflectance (ATR), enables rapid, non-destructive analysis of gelatin samples. Studies have demonstrated the effectiveness of FTIR-ATR in distinguishing gelatin derived from various animal sources, such as bovine, porcine, and fish, by analyzing specific spectral bands, such as Amide-I and Amide-II [1]-[3]. The integration of chemometric methods, for example Principal Component Analysis (PCA) and Partial Least Squares (PLS) regression, further enhances the accuracy and reliability of FTIR-ATR in gelatin authentication [2]-[4]. These methods enable the identification of unique spectral patterns and the development of classification models that accurately differentiate gelatin by animal origin, thereby supporting the authentication of halal and non-halal gelatin 4 5.

PCR techniques, on the other hand, offer a molecular approach to gelatin authentication by targeting specific DNA sequences. Conventional PCR and real-time PCR (qPCR) have been employed to detect porcine DNA in gelatin samples, providing high sensitivity and specificity [6]-[8]. The use of species-specific primers targeting mitochondrial DNA regions, such as the cytochrome b gene, has proven effective in identifying porcine gelatin even in highly processed products 6 [7]-[9]. PCR-based hybridization techniques, including PCR-DNA chip assays, have also been highlighted as a reliable method to verify porcine DNA in gelatin capsules, outperforming conventional PCR in terms of sensitivity 6. Additionally, the development of novel genomic DNA-based reference materials for qPCR has further strengthened the halal authentication process, ensuring compliance with halal standards [10].

Despite advancements in FTIR and PCR techniques, challenges remain in the authentication of gelatin due to its transformation during processing and the close similarities among gelatin structures from different sources [11]. The integration of omics-based approaches, such as lipidomics, metabolomics, and proteomics, with chemometric analysis has the potential to overcome these challenges by providing a more comprehensive understanding of gelatin's molecular composition [12][13]. These advanced techniques enable the identification of specific biomarkers and metabolites that serve as reliable indicators of gelatin origin, thereby enhancing the accuracy of halal authentication [12][13].

In conclusion, the combination of FTIR Spectroscopy and PCR techniques offers a complementary analytical approach for the halal authentication of gelatin. FTIR-ATR, coupled with chemometric methods, provides a rapid, non-destructive means of analyzing gelatin samples, while PCR techniques offer high sensitivity and specificity for detecting porcine DNA. The integration of molecular and omics-based approaches may further enhance the reliability of these methods, addressing the challenges posed by gelatin's molecular complexity. As demand for halal products continues to grow, the development and refinement of these analytical techniques will be crucial to ensuring the integrity and authenticity of halal gelatin across industries.

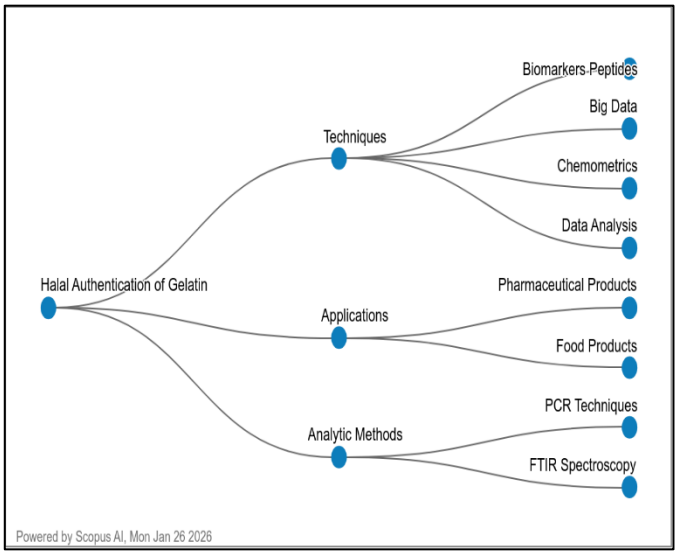

Figure 1. Concept paper on halal authentication of gelatin.

Figure 1 presents a concept map summarising the research landscape of halal authentication of gelatin, highlighting the interconnections among techniques, analytical methods, and applications. The map shows that halal authentication relies on a combination of advanced analytical methods, particularly PCR techniques and FTIR spectroscopy, which are widely used to identify the biological origin of gelatin and detect non-halal sources. These methods are complemented by supporting techniques such as chemometrics, data analysis, big data, and biomarker–peptide analysis, which enhance accuracy, reliability, and interpretation of complex datasets. The integration of these techniques enables a more robust discrimination of gelatin based on its biological source, even in highly processed materials, with particular relevance for detecting porcine-derived gelatin. In terms of applications, the concept map highlights the significance of halal gelatin authentication across food as well as pharmaceutical products, where gelatin is commonly used as an ingredient or excipient. Overall, the concept map illustrates that halal authentication of gelatin is a multidisciplinary field that combines molecular, spectroscopic, and data-driven approaches to address halal integrity challenges. This integrated framework supports regulatory compliance, consumer confidence, and the development of reliable halal assurance systems in modern food and pharmaceutical industries.

To systematically examine the intellectual landscape of halal authentication gelatin research, this study is guided by a set of research questions that focus on identifying publication patterns, scholarly influence, and collaborative trends within the field. Specifically, the research questions are designed to give a thorough bibliometric overview by analysing the temporal growth of publications, the impact of highly cited studies, and the geographical distribution of research output. In addition, the study explores thematic orientations through author keywords and examines international research collaboration by analysing co-authorship networks across countries. Together, these research questions offer structured insights into the evolution, influence, and global interconnectedness of halal gelatin authentication research, thereby contributing to a clearer understanding of its development and future research directions.

A. Research Questions

Q1. What are the research trends in halal authentication of gelatin based on the year of publication?

Q2. What are the most cited articles?

Q3. Where are the top 10 countries relying on the number of publications?

Q4. What are the author keywords related to the study?

Q5. What is the co-authorship by countries' collaboration?

II. METHODOLOGY

Bibliometric analysis comprises the structured collection, organisation, and quantitative examination of bibliographic data obtained from scientific publications [14]. It is widely used to explore the development and intellectual structure of a research field by examining trends in publication output, citation linkages, and scholarly relationships. Following basic descriptive indicators like publication year, journals, and authorship patterns [15], bibliometric studies also apply more advanced techniques, including co-citation and bibliographic coupling, to uncover connections between research works. Conducting a reliable bibliometric study requires a systematic, iterative process: beginning with the careful selection of keywords, followed by database searching, screening, and refinement to ensure data accuracy as well as relevance [16]. Accordingly, this research adopted a multi-stage bibliometric procedure involving keyword formulation, database retrieval, preliminary filtering, and final dataset refinement prior to analysis.

To maintain academic quality and methodological rigor, emphasis was placed on selecting publications from high-quality journals. Journals indexed in JCR and assigned an impact factor are generally regarded as indicators of strong scholarly standards [17]. Therefore, this study focused exclusively on peer-reviewed journal articles sourced from the Scopus database, which is frequently used in bibliometric research for its strict journal selection criteria and comprehensive citation coverage [18][19]. Compared with other databases, Scopus offers more consistent long-term coverage, particularly for earlier publications, making it suitable for analysing longitudinal research trends [20]. Articles indexed in Scopus from 2012 to December 2025 were included, while non-refereed sources were excluded to ensure data robustness [21][22]. Overall, the methodological design adopted in this study ensures that the bibliometric dataset is both comprehensive and academically robust, thereby providing a reliable foundation for analysing research trends, methodological developments, and knowledge structures within the selected research domain.

B. Data Search Strategy

The data for this study were collected using the Scopus advanced search function, which was selected for its extensive and well-established coverage of peer-reviewed academic literature. The search was conducted in October 2025 using the following query: TITLE-ABS-KEY((halal OR "halal authentication" OR "halal verification") AND gelatin AND (FTIR OR "FTIR spectroscopy" OR PCR OR "polymerase chain reaction")), as shown in Table I. This search string was carefully designed to retrieve publications explicitly addressing halal authentication of gelatin with a specific focus on the application of FTIR spectroscopy and PCR techniques, which are widely recognised analytical methods in halal verification studies. To ensure the academic rigor and reliability of the dataset, several refinement criteria were applied, as shown in Table II. The publication stage was restricted to final versions only, thereby excluding in-press articles that may not yet represent completed peer-reviewed research. In terms of document type, the search was limited to journal articles, as these provide validated empirical findings and theoretical contributions essential for bibliometric analysis. Additionally, only English-language publications were included to preserve uniformity in analysis as well as interpretation. Publications that did not meet these criteria, including non-English works and non-final publications, were excluded. Following the application of these filters and screening criteria, a total of 71 documents were retained for analysis. Although relatively focused in size, this dataset represents a highly relevant and methodologically coherent body of literature, providing a solid foundation for examining research trends, influential studies, and collaborative patterns in the field of halal gelatin authentication using FTIR and PCR techniques.

TABLE I. THE SEARCH STRING

Scopus	TITLE-ABS-KEY((HALAL OR "HALAL AUTHENTICATION" OR "HALAL VERIFICATION") AND GELATIN AND (FTIR OR "FTIR SPECTROSCOPY" OR PCR OR "POLYMERASE CHAIN REACTION"))

TABLE II. THE SELECTION CRITERION IN SEARCHING

Criterion	Inclusion	Exclusion
Language	English	Non-English
Time line	2012 – 2025	< 2012
Literature type	Journal (Article)	Book, Review
Publication Stage	Final	In Press

C. Data Analysis

A dataset containing the publication year, title, author name, journal, citation count, and keywords in PlainText format was obtained from the Scopus database for the period 2012 to December 2025 and analysed using VOSviewer version 1.6.15. The software was used to conduct the analysis and construct visual maps through the VOS clustering and mapping methods. VOSViewer is an alternative to the Multidimensional Scaling (MDS) approach [23]. It is similar to the MDS approach in terms of its aim, which is focused on the placement of items in a low-dimensional area in such a manner that the relatedness and similarity of any two items are reflected accurately by the distance between them [24]. Unlike MDS, which is focused on the computation of similarity measures such as Jaccard indexes and cosine, VOS implements a more suitable technique for normalising co-occurrence frequencies [25], such as the association strength (ASij), which is calculated as:

$$AS_{ij} = \frac{C_{ij}}{w_i w_j} \quad (1$$

which is "proportional to the ratio between on the one hand the observed number of co-occurrences of i and j and on the other hand the expected number of co-occurrences of i and j under the assumption that co-occurrences of i and j are statistically independent" [23]. Thus, VOSviewer maps the items by reducing the weighted sum of squared distances among all item pairs. Following [26], LinLog/modularity normalisation was applied. Moreover, the use of VOSviewer visualisation techniques on the dataset enabled the identification of patterns derived from mathematical relationships, alongside analyses including keyword co-occurrence and citation analysis.

The evolution of a research field over time may be examined through keyword co-occurrence analysis [27], which has proven effective in detecting prominent topics across various disciplines [28]. Meanwhile, citation analysis is valuable for identifying major research themes, emerging trends, and methodological approaches, while also revealing the historical significance of the core focus within a discipline [29]. Document co-citation analysis is also among the bibliometric techniques most commonly employed in previous studies [16][26][30], and the resulting map is constructed based on network theory to determine the underlying structure of the data [31].

IV. FINDINGS

A. RQ1: What are the Research Trends In Halal Authentication of Gelatin according to the Year of Publication?

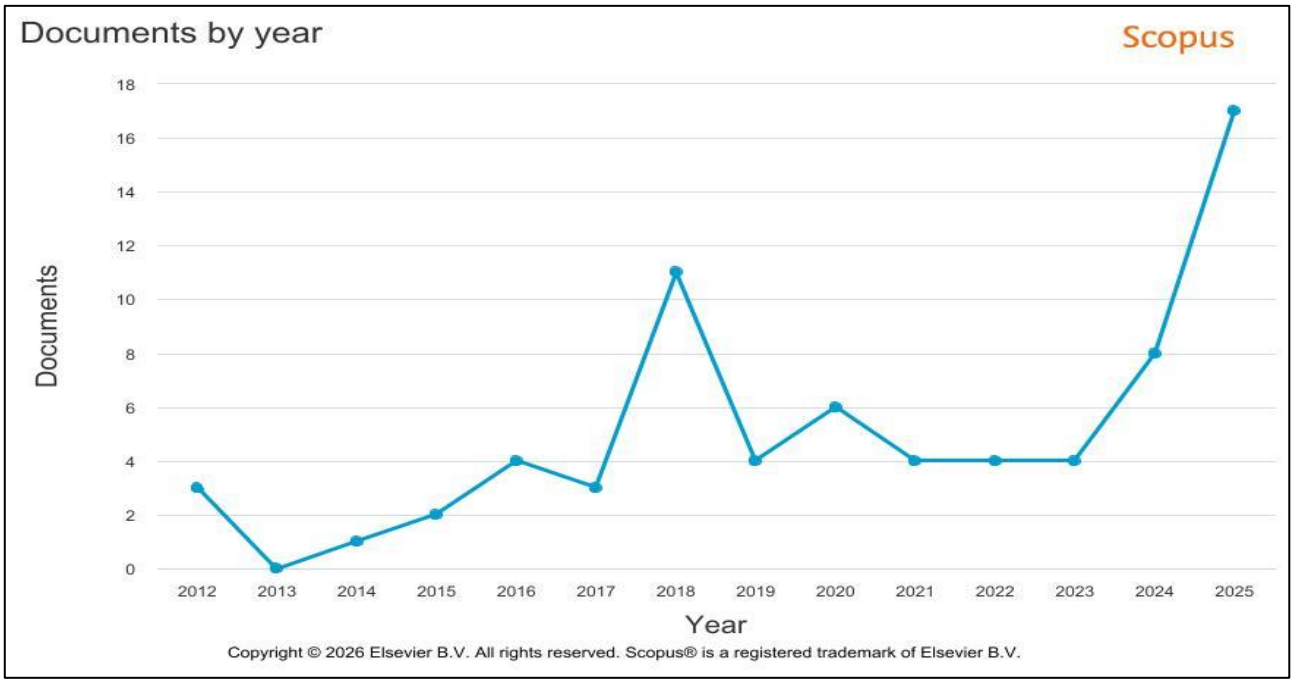

Figure 2. Research trends in halal authentication.

TABLE III. TREND OF RESEARCH IN HALAL AUTHENTICATION OF GELATIN BY YEARS

YEAR	NUMBER OF TRENDS
2025	17
2024	8
2023	4
2022	4
2021	4
2020	6
2019	4
2018	11
2017	3
2016	4
2015	2
2014	1
2012	3

Based on the publication trend from 2012 to 2025 shown in Figure 2 and Table III, research on halal authentication of gelatin using FTIR spectroscopy and PCR techniques demonstrates a gradual but uneven growth pattern, reflecting the evolving maturity of this niche field. Early publications between 2012 and 2015 show relatively low output (1–3 papers per year), which may be attributed to limited awareness of halal authentication as a distinct scientific domain and the initial adoption phase of FTIR and PCR for halal verification purposes. A noticeable increase appears in 2018, with 11 publications, indicating heightened scholarly attention. This surge coincides with growing global concern over halal integrity in food and pharmaceutical products, increased international trade of gelatin-based products, and stronger regulatory pressure in Muslim-majority countries. However, the decline in 2019–2023 (4–6 publications annually) suggests that research activity stabilized rather than expanded rapidly, likely due to the technical specialization of the topic and the dominance of a small group of research laboratories focusing on gelatin authentication.

A sharp increase is observed in 2024 (8 publications) and especially 2025 (17 publications), marking the highest output across the study period. This recent escalation can be explained by several converging factors: advancements in spectroscopic sensitivity, improved PCR-based species identification, increased interdisciplinary collaboration between food science, analytical chemistry, and halal studies, and stronger funding support for halal research aligned with food safety and traceability agendas. Additionally, the rising emphasis on halal assurance systems, consumer trust, and digital traceability has encouraged researchers to revisit FTIR and PCR as reliable, non-destructive, and rapid analytical tools. Overall, the publication trend reflects a transition from exploratory research toward a more consolidated and application-driven research phase, with recent years signaling renewed momentum and expanding academic interest in halal gelatin authentication.

B. RQ2. What are the Most Cited Articles?

TABLE IV. MOST CITED ARTICLES

Authors	Title	Year	Cited by
Çebi et al. [32]	A rapid ATR-FTIR spectroscopic method for classification of gelatin gummy candies in relation to the gelatin source	2019	102
Demirhan, Ulca & Senyuva [33]	Detection of porcine DNA in gelatine and gelatine-containing processed food products-Halal/Kosher authentication	2012	102
Sow et al. [34]	Structural Modification of Fish Gelatin by the Addition of Gellan, κ-Carrageenan, and Salts Mimics the Critical Physicochemical Properties of Pork Gelatin	2018	94
Shabani et al. [35]	Halal authenticity of gelatin using species-specific PCR	2015	89
Hamdan et al. [36]	Characterization and property investigation of microcrystalline cellulose (MCC) and carboxymethyl cellulose (CMC) filler on the carrageenan-based biocomposite film	2021	85
Rohman & Che Man [37]	Analysis of Pig Derivatives for Halal Authentication Studies	2012	71
Rohman et al.[38]	Review on analytical methods for analysis of porcine gelatine in food and pharmaceutical products for halal authentication	2020	69
Sultana et al. [39]	Multiplex PCR to discriminate bovine, porcine, and fish DNA in gelatin and confectionery products	2018	66
Rohman & Windarsih [40]	The application of molecular spectroscopy in combination with chemometrics for halal authentication analysis: A review	2020	58
Mutalib et al. [41]	Sensitivity of polymerase chain reaction (PCR)-Southern hybridization and conventional PCR analysis for Halal authentication of gelatin capsules	2015	54

Table IV addresses RQ2 by highlighting the most cited articles within the bibliometric dataset, which highlight the dominance of analytical authentication methods for halal gelatin, particularly ATR-FTIR spectroscopy and PCR-based techniques, reflecting their methodological reliability and regulatory relevance. The two most highly cited studies are [32] and [33], each with 102 citations that represent highly influential studies in spectroscopic and molecular approaches, respectively. [32] gained strong citation impact due to the introduction of a rapid, non-destructive ATR-FTIR method combined with chemometric classification, which offers practical advantages for routine halal monitoring in confectionery products. In contrast, [33] established species-specific PCR as a robust reference method for porcine DNA detection in gelatin matrices, providing high sensitivity and legal defensibility in halal and kosher authentication. The strong citation performance of [34] further reflects growing interest in gelatin substitution strategies, especially fish gelatin modification to mimic pork gelatin properties, which aligns with industry-driven halal reformulation needs rather than direct detection alone.

Overall, the citation pattern reveals that methodological robustness, applicability to real food and pharmaceutical products, and relevance to halal and kosher assurance are key drivers of scholarly influence. Reviews by [35][37][38] are highly cited because they consolidate analytical knowledge, standardize methodological frameworks, and directly support halal certification bodies. PCR-based studies remain highly influential due to their species-level specificity. At the same time, FTIR-based works gain traction for their speed, cost-effectiveness, and suitability for high-throughput screening, which is highly impactful because they offer rapid screening suitable for industrial use. Collectively, these widely cited works form an important methodological reference base in the field of halal gelatin authentication, with FTIR spectroscopy and PCR remaining among the most frequently applied approaches.

C. RQ3. Where are the Top 10 Countries Based on the Number of Publications?

Figure 3 illustrates the geographical distribution of publications related to halal gelatin research using FTIR spectroscopy and PCR, highlighting a strong concentration of outputs within a limited number of countries. The top ten contributing countries based on publication count are Indonesia (29), Malaysia (26), the United Arab Emirates (8), Saudi Arabia (4), Turkey (4), Iran (4), Pakistan (3), Egypt (3), India (3), and China (3). Collectively, these countries account for the majority of global research activity in this field. The dominance of Indonesia and Malaysia is particularly evident, reflecting their long-standing academic engagement in halal-related research and strong institutional support for food authentication studies.

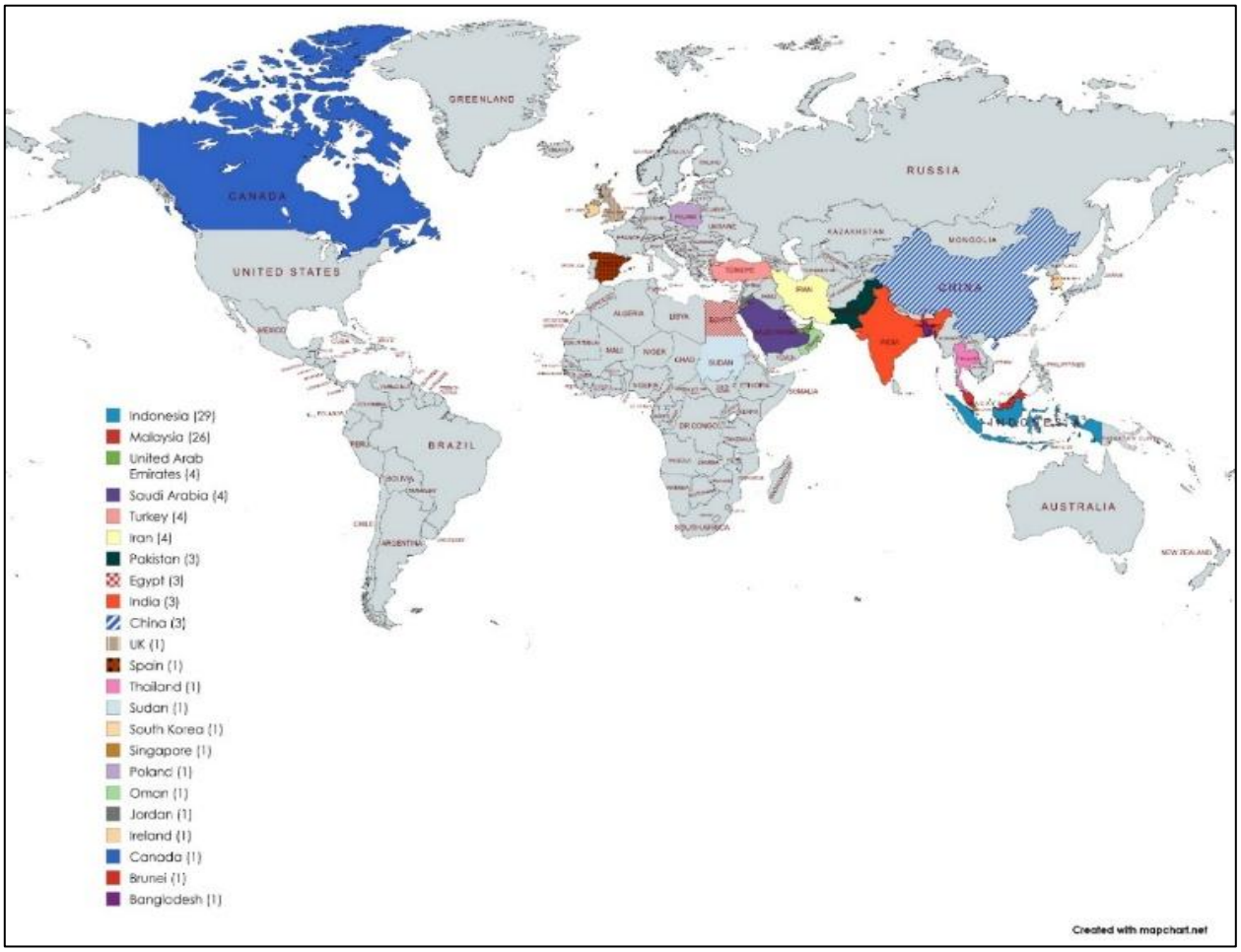

Figure 3. Top 10 countries based on publications.

The regional pattern shown in Figure 3 reveals that Muslim-majority countries and regions with more established halal regulatory frameworks are the principal contributors to this research area. In particular, countries in Southeast Asia and the Middle East demonstrate noticeably higher publication outputs, reflecting both the practical importance of halal compliance in these regions and the stronger institutional emphasis on halal-related research. By contrast, contributions from Europe and other regions remain comparatively limited, less concentrated, and more scattered across different countries.

This uneven distribution suggests that research activity is strongly associated with geographical contexts where halal certification systems are more developed, consumer awareness is higher, and concerns regarding food authenticity, traceability, and religious compliance are more pressing. It also indicates that the research agenda is shaped not only by academic interest, but also by regulatory demands, market needs, and socio-cultural relevance. Overall, Figure 3 points to a geographically concentrated research landscape in which scholarly output is largely driven by regional priorities and the operational significance of halal assurance, thereby explaining why publication activity is clustered within the top ten contributing countries identified in this study.

D. RQ4 - What are the Author Keywords Related to the Study?

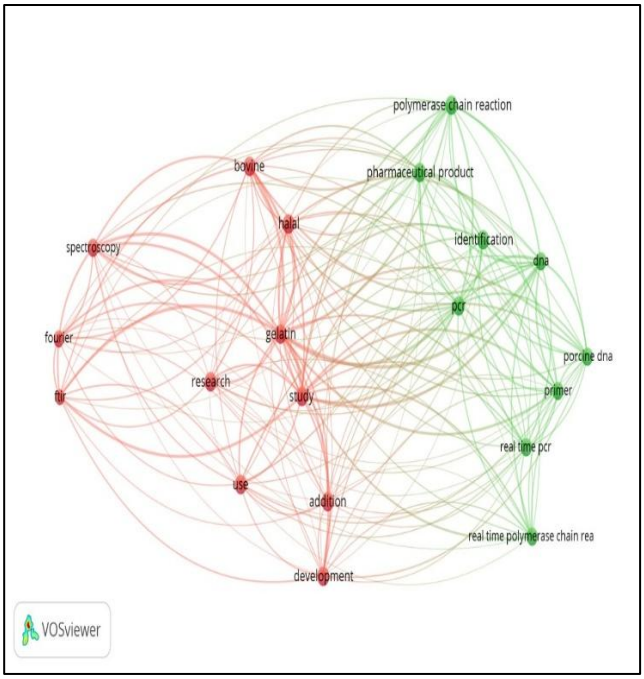

Figure 4. Author keywords

Based on the keyword co-occurrence analysis generated using VOSviewer in Figure 4, two main research clusters were identified in the network visualization. The keyword "gelatin" appears as the most central and dominant term in the network, with approximately 22 occurrences across the selected studies. This keyword forms the core of the red cluster. It is strongly linked with several related terms, such as "halal" (7 occurrences), "bovine" (8 occurrences), "FTIR" or "FTIR spectroscopy" (9 occurrences), and "spectroscopy" (4 occurrences). These keywords are positioned closely within the red cluster on the left side of the visualization, indicating a strong thematic concentration on the spectroscopic characterization and authentication of gelatin sources. The frequent co-occurrence between gelatin and FTIR suggests that Fourier Transform Infrared Spectroscopy is widely applied as an analytical technique for identifying gelatin composition and differentiating between bovine and porcine sources.

The second major cluster, represented in green in the visualization, focuses on molecular detection and DNA-based authentication methods. In this cluster, the keyword "polymerase chain reaction" or PCR appeared approximately 12 times, while "DNA" occurred about 10 times, making them among the most influential terms in this group. Other closely related keywords include "porcine DNA" (5 occurrences), "primer" (4 occurrences), "real-time PCR" (4 occurrences), and "identification" (3 occurrences). These terms are strongly interconnected in the network, reflecting their frequent co-occurrence in studies that investigate gelatin authentication using molecular biology techniques. The presence of "pharmaceutical product" as a connecting keyword further suggests potential application of these molecular detection approaches in pharmaceutical and food-related industries to verify halal status and detect adulteration. Overall, the visualization reveals two dominant research themes within the dataset, namely spectroscopy-based analytical characterization and PCR-based molecular authentication of gelatin sources.

E. RQ5 - What is the Co-authorship by Countries' Collaboration?

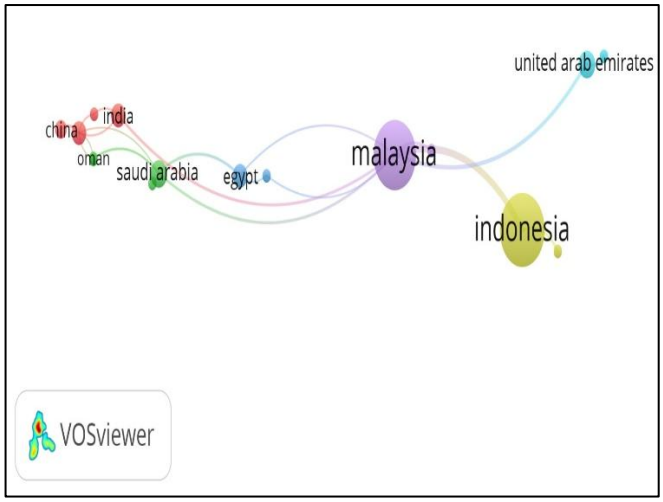

Figure 5. Co-authorship by countries.

The co-authorship analysis by countries generated using VOSviewer reveals the pattern of international collaboration among the selected studies. Based on the dataset, Indonesia recorded the highest contribution with 29 publications, followed by Malaysia with 26 publications, indicating that these two countries are the most active contributors in this research area. Other countries with moderate contributions include the United Arab Emirates, Saudi Arabia, Turkey, and Iran, each with 4 publications, while Pakistan, Egypt, India, and China contributed 3 publications each. Several additional countries, such as the United Kingdom, Spain, Thailand, Sudan, South Korea, Singapore, Poland, Oman, Jordan, Ireland, Canada, Brunei, and Bangladesh, each contributed one publication. The network visualization further illustrates that Malaysia serves as a central node linking collaborations with several countries, including Indonesia, the United Arab Emirates, and Egypt.

Meanwhile, Saudi Arabia forms collaborative connections with China, India, and Oman. The size of the nodes in the network reflects the number of publications produced by each country, while the connecting lines indicate collaborative relationships between countries. Overall, Figure 5 demonstrates that research in this field is characterized by regional collaboration, particularly among countries in Asia and the Middle East, with Malaysia and Indonesia acting as key hubs facilitating international research cooperation.

V. CONCLUSION

This study provides a comprehensive bibliometric overview of research on halal authentication of gelatin with particular emphasis on the application of FTIR spectroscopy and Polymerase Chain Reaction techniques. The analysis of publication trends shows that research activity in this field has gradually expanded over time, reflecting increasing scientific attention toward ensuring the authenticity of gelatin used in food and pharmaceutical products. Although early studies between 2012 and 2015 recorded relatively low publication output, the number of publications increased noticeably in subsequent years, with a significant surge observed in 2024 and 2025. This pattern suggests that halal authentication of gelatin has moved beyond an exploratory phase toward a more established and application-oriented research area. The rising demand for halal-certified products, combined with stricter regulatory frameworks and growing consumer awareness, has encouraged researchers to further develop analytical methods capable of accurately identifying gelatin sources. As a result, FTIR spectroscopy and PCR techniques have become central tools in addressing the need for reliable halal verification methods.

The citation analysis further demonstrates that the most influential studies in this field focus primarily on the development and validation of analytical techniques for gelatin authentication. Highly cited works emphasize the reliability and practicality of FTIR spectroscopy and PCR-based methods in identifying porcine contamination and differentiating gelatin sources. Spectroscopic techniques such as ATR-FTIR are widely recognised for their rapid, non-destructive, and cost-effective analytical capabilities. At the same time, PCR methods provide high sensitivity and species-specific detection through DNA analysis. The keyword co-occurrence analysis reinforces these findings by revealing two major research themes within the literature. One cluster highlights the use of

spectroscopic techniques for structural and compositional analysis of gelatin. In contrast, the second cluster focuses on molecular biology approaches such as PCR and DNA identification for detecting porcine gelatin. These two methodological streams complement each other and collectively form the core analytical framework for halal authentication studies.

In addition to methodological development, the results also highlight the geographical and collaborative structure of research in this field. The analysis of publication distribution shows that Indonesia and Malaysia are the most productive countries, reflecting strong institutional support and active research communities dedicated to halal science. Other countries, such as the United Arab Emirates, Saudi Arabia, Turkey, and Iran, also contribute to the growing body of literature, while several additional countries participate through smaller-scale contributions. The co-authorship network further illustrates that Malaysia functions as a central collaboration hub connecting research partnerships with Indonesia, the United Arab Emirates, and Egypt. At the same time, Saudi Arabia forms additional collaborative links with China, India, and Oman. This pattern indicates that international collaboration in halal gelatin authentication is largely driven by regional partnerships within Asia and the Middle East, where halal compliance is of major economic and cultural importance. Overall, the findings of this study demonstrate that research on halal authentication of gelatin is steadily evolving through methodological innovation, increasing publication activity, and expanding international collaboration, all of which contribute to strengthening the scientific foundation of halal assurance systems.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

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