

Knowledge diffusion of Halal food research: a main path analysis.

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Knowledge Diffusion of Halal Food Research: A Main Path Analysis

Abstract

Purpose: Halal food (HF) has received significant attention from scholars and practitioners. However, no studies have explored the distinct role played by HF literature as part of knowledge diffusion. Given the increasing number of scholarly outputs, this study has aimed to examine the HF development over the past decades comprehensively, including emerging topics and knowledge transmission paths and structure.

Design/ methodology/ approach: This study conducted a keyword co-occurrence network analysis and Main Path Analysis (MPA). The MPA included four types of main paths to trace the historical formation of HF based on 253 articles extracted from the Web of Science.

Findings: The findings show that: (1) HF research revolves around several dimensions, including HF safety and trust, halal certification, HF supply chain management, and attitudes towards HF purchasing and (2) the focus of HF research has shifted from the business perspective to the consumer perspective. In recent years, there has been a trend to explore how blockchains can benefit HF supply chains by improving traceability, transparency, and consumer trust in HF.

Originality/ value: This study addresses the need to examine the knowledge diffusion paths in the HF domain. It offers a framework to investigate the knowledge dissemination and structure, helping researchers deal with hundreds of articles effectively and increasing their understanding of the past, present, and future research trends in the HF domain.

Keywords: Halal food, keyword co-occurrence network, main path analysis, knowledge diffusion

1. Introduction

Research on halal food (HF) has been proliferating since 2012 (Secinaro & Calandra, 2021). The significant attention being paid to HF is attributed to the increasing demand for halal products and services and the profitability of the halal market segment (Awan, Siddiquei, & Haider, 2015; Rejeb, *et al.*, 2021). According to Muhamed, *et al.* (2019), the high manufacturing standards, the practices necessary to develop an integrated supply chain, the requirements of halal certification, and the increasing size of the world’s Muslim population have significantly contributed to the growing demand for HF. Beyond Muslim consumers, HF appeals to Non-Muslim consumers as the HF market is expanding rapidly in non-Muslim majority nations, including Asia-Pacific, Europe, and the Americas (Mostafa, 2020a). The HF sector is essentially based on the production and delivery of goods and services in a way that is compliant with the Islamic dietary law, or Sharia, thereby avoiding the use of products and practices prohibited (Haram) (Tieman, 2011; Wilson, 2014). The doctrine of halal extends from the Islamic ritual slaughter and consumption behaviour to every aspect of Muslim life, including the business and management sectors (Ab Talib, 2017). As a result, the HF industry is not solely religious-compliant; instead, it is turning into an economic force and income generator.

In the context of food, the concept of halal is holistic in terms of both physical attributes and moral sense in the entire HF supply chain (Ab Rashid and Bojei, 2019; Hassan and Pandey,

2019). In other words, the production and delivery of authentic HF is a top priority for consumers and food producers. From the consumer perspective, HF consumption represents an essential requirement and a symbol of the Muslim culture and identity. For HF producers and supply chain partners, maintaining HF integrity at the point of consumption (Tieman, 2011) is the precondition for the success of the halal industry. As per Ab Rashid and Bojei (2019), each HF supply chain actor, ranging from suppliers to end-users, must be monitored to achieve untainted HF integrity and increase consumer trust in HF authenticity. For example, apart from safety and quality, HF should be free from unlawful and forbidden ingredients such as pork derivatives (e.g., lard, porcine gelatin) and non-halal meat (e.g., rat meat, dog meat) (Rohman and Windarsih, 2020). Similarly, any machinery used to prepare, handle, and process HF should not be contaminated by non-halal components. Therefore, the complexities and vulnerabilities of HF supply chains are managed by a set of developed and regulated activities by a governing body that pre-validates the compliance to the halal requirements.

Considering the importance of HF and its acceptance even amongst Non-Muslims (Ab Talib and Ai Chin, 2018; De Boni and Forleo, 2019; and Mostafa, 2020a), the literature on this subject is relatively new, and has increased significantly over the recent years. Accordingly, Wibowo, *et al.* (2020) argued that the purchase intention on HF amongst the non-Muslim consumers remains inconclusive in which would lead to the hesitation amongst the non-Muslim consumers to purchase HF. Thus, the degree of HF knowledge amongst non-Muslim consumers significantly influences their evaluation or attitude towards HF (Krishnan, *et al.*, 2017). Knowledge would provide the necessary informational basis for consumers in terms of their decision-making purposes (Carlson, *et al.*, 2009). Consequently, the rapid growth of HF research provides a sound justification for investigating this domain systematically. Although several valuable attempts have been made to summarise previous studies pertaining to HF, there is still a lack of papers examining the whole HF domain systematically. For instance, Mostafa (2020a) used knowledge domain visualisation to review the HF knowledge structure through the analysis of information associated with authors, publications, and keyword networks. Secinaro and Calandra (2020) used bibliometrics to analyse the journals, articles, authors, citations, keywords, and countries in the HF literature. Likewise, Rejeb, Rejeb, and Zailani (2021) made a systematic literature review of 74 articles to explore the inherent sustainable aspects of HF supply chains. Finally, Ab Talib (2017) reviewed the motivation and advantages of implementing HF supply chains from the supply side. Although these reviews offer valuable insights into the HF literature, the authors were unable to locate any study that scrutinised the knowledge diffusion trajectories of this field by employing the main path analysis (MPA), which has been widely adopted in several fields (Barbieri, *et al.*, 2016; Fu, *et al.*, 2019; and Xiao, *et al.*, 2014). Therefore, to fill this gap, the current study has investigated the knowledge development and evolution of the HF domain through the MPA.

This review has aimed to combine keyword co-occurrence network analysis and MPA to cover the entire field of HF comprehensively. Adopting these approaches, we have aspired to identify the topics discussed in the literature and depict the knowledge diffusion paths and structures. Furthermore, these quantitative techniques can reduce the analysis bias created by subjectivity and enable researchers to compile and analyse a large sample of papers more effectively. These methods can not only motivate scholars to enhance their complete understanding of the historical development of the HF domain but can also be valuable for them to recognise the current state of HF and unravel future research directions.

The contributions of this research are as follows. First, in terms of research, the adoption of co-occurrence network analysis along with MPA is still left ignored in previous studies, thus

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making the current study novel and unique. Second, the use of the MPA serves to depict the genealogy of the HF research and provide comprehensive interpretations and analysis of this knowledge domain from different approaches, including the local, global, and key-route main paths. After identifying the research hotspots, the researchers were able to trace and visualise the most relevant trajectories of HF research and the most recent active research areas. The remainder of this paper is structured as follows. After the introduction, we briefly summarise the main review studies on HF to differentiate our research from previous works. The details related to data collection and methodology are presented in section 3. The keyword co-occurrence network analysis is discussed in section 4, followed by the description of the MPA method in section 5. In section 6, we discuss the review findings, and next, we briefly conclude the paper.

2. Main review studies on HF

The last few years have seen a rapid increase in the number of HF studies. In this regard, several efforts have been devoted to systematically summarising the prior works on the HF topic. The studies presented in Table 1 predominately conducted traditional literature reviews or bibliometric analyses to synthesise the literature and extract novel insights. For example, Martuscelli, *et al.* (2020) and Nakyinsige, *et al.* (2012) reviewed the literature surrounding halal meat and elaborated on the analytical methods necessary to overcome HF fraud and adulteration issues. Neio Demirci, *et al.* (2016) discussed the issues associated with food safety in halal assurance and argued that the “Toyyiban” notion, meaning wholesome or good, appears to be one of the determinants playing a role in harmonising halal standards. Moreover, Ab Talib (2017) examined the motivation and advantages of implementing HF safety certification from the upstream perspective. Ali and Suleiman (2018) provided a wider view of supply chain management in the HF industry and found eleven challenges in maintaining food integrity in the HF supply chain. These included purity and origins of raw materials, halal quality, over-reliance on halal certification, and quality assurance, to name a few. From a geographical perspective, Henderson (2016) explored the challenges of HF and its importance in halal tourism in both Malaysia and Singapore. According to the author, the cases of these countries suggest that destinations with majority and significant minority Muslim populations have a competitive advantage related to HF for tourists, which is perhaps to be increased if reasonably solid and trustworthy certification schemes are in place. In the Korean context, Bashir, *et al.* (2019) investigated the current and future status of foreign HF marketing and developed strategies for strengthening the competitiveness of Korean seafood businesses in the global HF market.

When it comes to bibliometric analyses, a few studies have attempted to explore the HF food literature in a comprehensive manner. For example, Secinaro and Calandra (2020) applied bibliometrics to classify the key themes in HF, highlight future research opportunities, and put forth a research agenda. The findings of their study showed that the literature revolved around diverse themes, including HF and the role of certifications, HF and awareness, HF production and quality, and HF in hospitality and supply chain management. The major research flows were found to originate from Asia, with collaborations being formed in other continents. Similar to the study of Secinaro and Calandra (2020), Mostafa (2020) conducted a comprehensive analysis of HF research using a knowledge domain visualisation technique to examine the main bibliometric profile of the field, its prominent authors, its key journals, its representative works, its collaborative flows, its research hotspots, and its paradigm shifts and intellectual structure. The authors found that HF research networks exhibit what is frequently termed the Matthew Effect in sociology, which is defined as the preferential attachment

wherein a small number of hubs have a higher number of connections than the rest of the actors in the network. To explain the relationship between food safety and HF, Wahyuni, *et al.* (2019) conducted a bibliometric analysis and identified the impactful studies, scholars, and universities contributing to the HF field. Recently, Handayani, *et al.* (2021) aimed to comprehend halal suppliers in the food supply chain to achieve halal standards from upstream to downstream, employing a bibliometric analysis.

Three studies combined a systematic literature review with bibliometric analysis to examine halal research in general (Haleem, *et al.*, 2020), sustainable HF supply chains (Rejeb, Rejeb, and Zailani, 2021), and the current state of the Internet of Things (IoT) in the HF supply chain (Rejeb, Rejeb, Zailani, *et al.*, 2021). HF scholars also tried to generate high-quality evidence concerning HF using systematic literature reviews, and the findings were published on three separate occasions. The first systematic review was published by Naeem, *et al.* (2019), and it focused on examining qualitative papers related to HF consumption. In the second systematic review, Ramli, *et al.* (2021) attempted to determine the barriers to the acceptance of HF and to explain the necessary communication ways to convey the halal concept across the different world regions. Finally, Iranmanesh, *et al.* (2021) systematically reviewed the literature regarding consumer behaviour toward HF and identified several gaps for future research.

Despite the abundance of review studies to systematise the HF literature, the use of traditional and systematic literature reviews is not always the best option as they are rather labour-intensive, subjective, and inappropriate for studying larger volumes of literature (Vijayakumar, *et al.*, 2018). The existing variety of research streams applying bibliometric tools to examine HF are quite limited. In addition, existing bibliometric studies either utilised different bibliometric tools that resulted in different insights (Mostafa, 2020b) or were unable to trace the knowledge diffusion trajectories in the HF field. To address these limitations, in this work, we conducted a main path analysis (MPA) of the HF literature. We aimed to increase scholars' and practitioners' understanding of the evolution of HF research and the critical works contributing to the knowledge diffusion process in this area. Because of the inherent outstanding nature of keyword clustering and MPA in examining a substantial amount of research works, this study concentrated on the development of the entire HF domain by applying both methods. More importantly, in picking influential publications for the analysis, the current study has been based on quantitative methods which are objective and unbiased. In addition, with the keyword co-occurrence analysis, the core content of HF research was analysed in this study, which can offer the reader the research fronts or trends in the HF literature. Furthermore, the MPA served to investigate the citation linkages between influential papers and a sequence of historical events that have significantly contributed to the formation of the knowledge diffusion paths of the HF domain fully. This simplification is highly useful for new researchers who are contemplating entering the HF research field.

| No. | Article | Scope | Time span | Number of reviewed papers | Method | Contributions |
|-----|--------------------------------------|--|----------------------------|---------------------------|-----------------------|--|
| 1 | (Handayani, <i>et al.</i> , 2021) | Halal suppliers in the food supply chain | 2008-2020 | 142 | Bibliometric analysis | Understand halal suppliers in the food supply chain to ensure halal standards from upstream to downstream |
| 2 | (Secinaro and Calandra, 2020) | HF | 1997-2020 | 221 | Bibliometric analysis | Categorise the relevant themes in HF, highlight future research directions, and provide a research agenda |
| 3 | (Mostafa, 2020b) | HF | 1990-2019 | 290 | Bibliometric analysis | Analyse the intellectual structure of the HF research over three decades Identify the most influential scholars, journals, publications, collaborative patterns, and research hotspots in the HF literature |
| 4 | (Wahyuni, <i>et al.</i> , 2019) | Food safety and HF | 1990-2018 (until February) | 120 | Bibliometric analysis | Summarise the literature surrounding food safety and HF for supply chain researchers Explain the relationship between food safety and HF |
| 5 | (Martuscelli, <i>et al.</i> , 2020) | Halal meat products | NA* | NA | Literature review | Discuss the qualitative and technological aspects of halal raw meat Focus on the certification system and the analytical methods conducted to address problems like fraud and adulteration of HF |
| 6 | (Ali and Suleiman, 2018) | Food integrity | NA | NA | Literature review | Offer a broader view of supply chain management in the HF industry Provide insights into how to safeguard the integrity of HF products |
| 7 | (Ab Talib, 2017) | HF safety certification | NA | NA | Literature review | Review the motivation and benefits of adopting HF safety certification from the upstream perspective Advance the knowledge related to HF supply chain considering the internal and external impetuses and benefits of the HF supply chain |
| 8 | (Neio Demirci, <i>et al.</i> , 2016) | Food safety in halal assurance | NA | NA | Literature review | Discuss issues connected to food safety in halal assurance Identify and explain the approach to food safety requirements in HF provision and how this is integrated into the halal assurance systems |
| 9 | (Henderson, 2016) | HF, certification, and halal tourism | NA | NA | Literature review | Examine issues of HF and its role in halal tourism in the context of Malaysia and Singapore |
| 10 | (Nakyinsige, <i>et al.</i> , 2012) | Halal meat | NA | NA | Literature review | Identify what makes meat halal, outline the halal authenticity issues occurring in meat products, and summarise the potential analytical tools for halal authentication of meat products |
| 11 | (Bashir, <i>et al.</i> , 2019) | Korean seafood companies | NA | NA | Literature review | Examine the actual and future status of overseas HF marketing |

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| 12 | (Rejeb, Rejeb, Zailani, <i>et al.</i> , 2021) | The Internet of Things in the HF supply chain | 2008-2020 | 73 | Systematic literature review+ bibliometric analysis | Develop strategies for enhancing the competitiveness of Korean seafood companies in the international HF market Offer in-depth insight into the current state of IoT research in the HF literature, its challenges, and future research opportunities |
| 13 | (Haleem, <i>et al.</i> , 2020) | Halal research | 2006-2019 | 946 | Systematic literature review+ bibliometric analysis | Identify top scholars contributing to halal research, the critical sub-research areas, and the influential studies based on citations and PageRank Report established and emerging research clusters |
| 14 | (Rejeb, Rejeb, and Zailani, 2021) | Sustainable HF supply chains | 2007-2019 | 74 | Systematic literature review+ bibliometric analysis | Offer a comprehensive analysis of the economic, social, and environmental dimensions of sustainability in the context of HF supply chains |
| 15 | (Ramli, <i>et al.</i> , 2021.) | A systematic review on the barriers to the acceptance of HF amongst non-Muslim consumers | 2010-2020 | 14 | Systematic literature review | Identify the barriers to the acceptance of HF Explain efficient ways of communication for disseminating the halal concept in various regions of the globe |
| 16 | (Iranmanesh, <i>et al.</i> , 2021) | Consumer behaviour towards HF | 2007-2020 | 96 | Systematic literature review | Provide deep insights into the actual state of HF literature Identify many gaps in the literature and propose future avenues to increase the understanding of customer behaviour towards HF |
| 17 | (Naeem, <i>et al.</i> , 2019) | HF consumption | 1990-2017 | 11 | Systematic literature review | Review all qualitative papers related to HF consumption |
| | This paper | HF research | 1970-2020 | 253 | Keyword co-occurrence analysis+ main path analysis | Explore the core content of HF research Examine the knowledge diffusion paths Highlight possible future research directions |

Table 1. Overview of the main review studies in the HF domain

*NA: Not applicable

3. Data collection and methodology
3.1. Data collection

Data quality is paramount to obtain valuable results. Based on this, we selected the Web of Science (WoS) database as our data source. According to Xiao, *et al.* (2014), WoS is recognised as a leading academic database covering a high number of impactful journals. Additionally, it is widely chosen for MPA and bibliometric research thanks to its high quality and comprehensive coverage (Fetscherin & Heinrich, 2015; Mostafa, 2020a). The detailed process of the review is depicted in Figure 1.

The search string used in this review was as follows: Topic Search (TS)= “halal food”. This study selected all the databases in the WoS, including Science Citation Index Expanded (SCI-EXPANDED) and Social Sciences Index (SSCI). The review considered English language speaking articles (including reviews) that were published from 1970 to 2020. In total, the search query returned 253 documents, which were collected and downloaded from the WoS database.

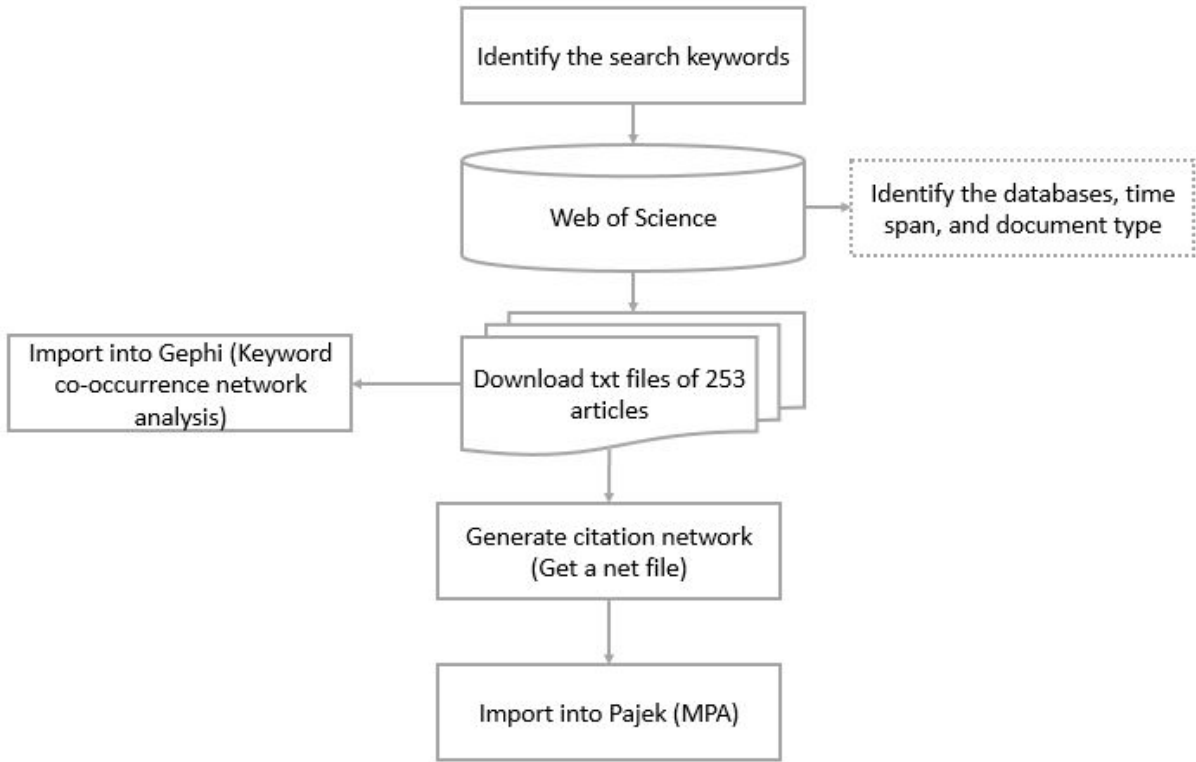


Figure 1. The review processes

3.2. Methodology

According to Chen, Zhang, and Fu (2019), several citation-based analyses like bibliographic coupling analysis, co-citation analysis, and MPA have been widely used to identify the intellectual structure and development trajectories of a domain thanks to the substantial information included in the citations of papers. The core of bibliographic coupling is to study the common intellectual background of publications (Kessler, 1963) based on the assumption that the more shared references between the two papers, the stronger their common intellectual foundation (Li, *et al.*, 2018). As a static measure, bibliographic coupling indicates the production in lieu of the consumption of scholarly publications and helps to detect research fronts in a particular scientific field (Yoon, 2019). However, article co-citation analysis is

helpful to explore structure, dynamics, and paradigm developments (Liu, *et al.*, 2015). This bibliometric method analysis co-cites publications, explores the link between them, and uncovers the uniformity of concepts and references regarding their association to the subject under investigation (Chen, *et al.*, 2010). In an article co-citation network, highly co-cited documents illustrate advanced concepts, ideas, and developments in a particular research field.

To analyse a citation network, Hummon and Dereian (1989) proposes MPA as a valuable means to capture the knowledge flow according to the direct citation relationships between publications. Because of its effectiveness, the MPA is adopted in the field of social network analysis (Hummon and Carley, 1993) and conflict resolution (Carley, *et al.*, 1993). In later years, Batagelj (2003) introduced a novel algorithm called search path count (SPC). Liu and Lu (2012) contributed to the MPA by suggesting several new methods, including the key-route main path. Besides this method, current main paths also include local main path (forward and backward) and global main path. In this study, we used a technique of citation network (see Figure 2), which was explained by Liu and Lu (2012) to clarify how the main path is constructed and how the citation network is weighted.

In Figure 2, the citation network contains nodes and arrows. The former represents publications, and the latter represents the diffusion of ideas and the direction of knowledge flows. As can be seen, three types of nodes exist in the citation network: sources (green nodes), intermediates (red nodes), and sinks (yellow nodes). Sources are the nodes that are only cited by other nodes, whereas sinks are the nodes that only cite other nodes. The intermediate nodes are the ones that cite and are cited by other nodes. The SPC of each link is determined by the total number of times the link is traversed by the paths from sources to sinks. For instance, the SPC of link D-G is 2 because there are 2 paths traversing it, which are B-D-G-I and B-D-G-J.

After weighting the links of the citation network, the subsequent task is to construct main paths using diverse search algorithms. Searching from sources to sinks, the forward local main path selects the largest SPC value amongst all links stemming from a node. To illustrate, two links are coming from the node C, C-E, and C-I. Link C-E is chosen as its SPC is greater than of link C-I. After that, node E is chosen as the starting point for the next search. When the sink is hit, the search will terminate. The forward local main path can be constructed, which is, according to the figure, the pair of B-D-G-I and B-D-G-J.

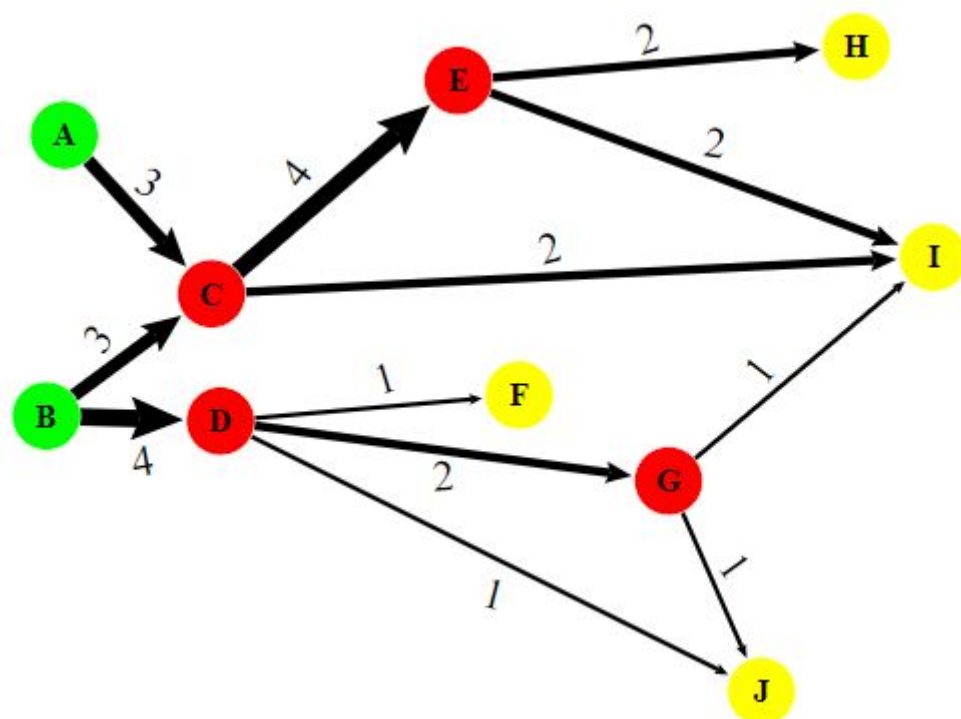


Figure 2. A typical citation of the network with SPC values

As opposed to the forward local main path, the backward local main path searches from sinks to sources, that is, from the latest publications to earlier publications. Overall, six links connect to the sink nodes F, H, I, J. The first task consists of selecting the links with the highest SPC, namely, 2. If any sources are reached, the search will terminate. Therefore, the backward local main path in the citation network is the combination of paths A-C-E-H, A-C-E-I, A-C-I, B-C-E-H, B-C-E-I, and B-C-I. Given that the local main path concentrates on the local maximum, the global main path concentrates on the overall maximum. As such, the global main path is used to explore the path with the largest accumulated SPC value. Here, A-C-E-H, A-C-E-I, B-C-E-H, and B-C-E-I are the main global paths because the total SPC value on these links is the maximum amongst all paths from the source nodes to the sink nodes.

Despite the advantages of the abovementioned search algorithms, the local main path and the global main paths do not comprise the links with the largest SPC. To address this issue, Liu and Lu (2012) proposed a new method named the “key-route” main path. Four steps are needed to obtain this path. The first step is to choose the link with the largest SPCs in the citation network as the key-routes. Here, the key-routes are B-D and C-E. The second step is to search forward from the end node of the key-route (D and E) until a sink node is reached, and to search backward from the start node of the key-route (B and C) until a source node is reached. During this step, the local method or global method can be used to obtain the key-route main path. If the local method is adopted, links B-D-G-I and B-D-G-J are determined from the key-route B-D, and links A-C-E-H and A-C-E-I are determined from the key-route C-E. In this citation network, the key-route local main path is like the key-route global main path. Essentially, the number of top citation links in constructing the key-route main paths is arbitrary. That is, the more key routes are selected, the greater details will be presented. If we want to show more key-routes, the top two key-routes are A-C and B-C. Repeating the second step, the second key-route main path will be identified.

The combination of the local, global, and key-route main path analyses helps to exhibit and identify the development trajectories of a research domain from different perspectives. Whilst the local main path focuses on the local maximum and selects the most important links at each conjecture, they may neglect the path with the largest accumulated SPC value. As a result, the global main path is chosen for further analysis along with the key-route main path, thereby capturing all the most influential connections in the citation network. Based on the four main paths, this paper aimed to exhibit the HF domain's development trajectories ultimately. In other words, the combination of these four paths enabled us to systematically understand the evolution of the HF research in the last decades and to uncover the works that have made substantial contributions to the development of the HF knowledge body.

4. Keyword co-occurrence network analysis

Keywords can provide readers with the core content of papers, and their analysis can reveal hot topics and emerging research frontiers of a specific domain (Zhu and Hua, 2017). In this study, the semantic development of the HF domain has been explored with the assurance of Gephi since it represents the leading visualisation and exploration tool for all types of graphs and networks between different objects (Zhang, *et al.*, 2018).

The research generated a keyword co-occurrence network, which contained 149 nodes and 725 links. The modularity index was 0.371, which illustrates significant connections amongst all the keywords in the network and indicates a significant overlapping amongst the generated clusters. This modularity was based on the Louvain algorithm, which represents an iterative optimisation model that helps to determine the optimal number of partitions (clusters) that maximises the modularity index (Blondel, *et al.*, 2008). In the co-occurrence network, the font and node size reflect the frequency of the keywords in the sample of records, and the width of edges between nodes reflects the co-occurrence frequency of the two keywords.

Applying the Louvain algorithm to the 149- node network, six major clusters were generated, as shown in Figure 3. Table 2 provides detailed information about each cluster. It can be seen from the figure that the largest cluster is the red one. This cluster revolves around HF safety and trust. In current days, the demand for safe and HF continues to rise because Muslim consumers want assurance for their foods to abide by the religious requirements and include hygiene, sanitation, and safety qualities (Ab Talib, *et al.*, 2015). Food safety constitutes an integral part of the halal concepts (Demirci, Soon, & Wallace, 2016) that can remarkably impact HF consumption. For instance, HF safety is perceived as being critical in meeting consumer needs for high-quality food products, free from contaminants, be it chemical, biological, or physical. Over time and given the exponential demand for ensuring food safety, studies around HF safety have stood out, which may be considered a hot topic in the future.

The second cluster (blue colour) is attitudes toward HF purchasing. Studies in this cluster included the variables that affect HF purchasing decisions such as attitudes, behaviours, subjective norms, and HF awareness. The third cluster (yellow colour) centres on halal certification. The fourth cluster (green colour) was formed by 24 keywords, and it is associated with the concept of HF supply chain management. The HF supply chain begins with sourcing different permitted raw materials and preparing them according to halal guidelines. In the fifth cluster (purple colour), some studies were identified to focus on HF marketing, suggesting that HF marketing and management need to be in line with Islamic law (Ashraf, 2019). Halal marketing is related to business literature and implies that halal guidelines can shape consumer behaviours and attitudes towards HF. Issues associated with HF marketing involve positioning,

branding, packaging, and labeling of food products (Wilson, 2012; Wilson and Liu, 2011). Keywords in this cluster included halal market, Islamic marketing, halal logo, etc. The last cluster (gray colour) indicates that the adherence to Islamic law is the source of direction and reference for proper HF processes.

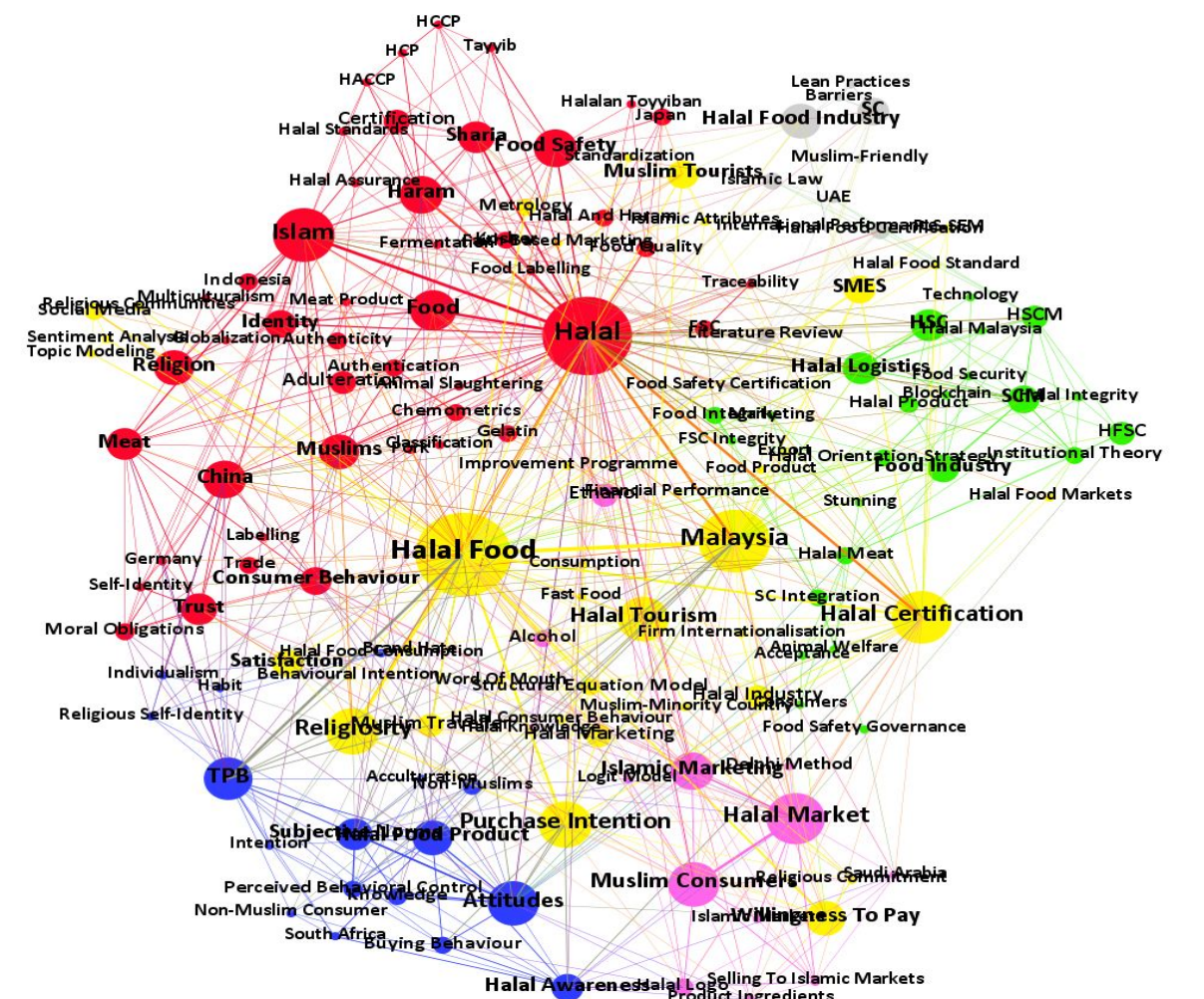


Figure 3. Keyword co-occurrence network

Table 2. The clusters of keywords

| Cluster | Size | Topic | High-frequency keywords |
|---------|------|---------------------------------|---|
| 1 | 46 | HF safety and trust | Halal; Islam; Food; China; Food Safety; Haram; Muslim; Religion; Meat; Trust; Consumer Behaviour |
| 2 | 17 | Attitudes towards HF purchasing | Attitudes; TPB; Halal Food Product; Subjective Norms; Halal Awareness |
| 3 | 38 | Halal certification | Halal Food; Malaysia; Halal Certification; Purchase Intention; Religiosity; Halal Tourism; Willingness To Pay |
| 4 | 24 | HF supply chain management | Halal Logistics; HSC; Food Industry; SCM; HFSC; HSCM; Food Integrity; |
| 5 | 13 | HF marketing | Halal Market; Muslim Consumers; Islamic Marketing; Ethanol; Alcohol; Halal Logo |
| 6 | 11 | Islamic law | Halal Food Industry; SC; Halal Food Certification; Islamic Law; Literature Review |

5. Main path analysis of the HF domain

This section presents the citation network analysis of the selected sample, followed by the discussion of the findings of the four main paths, namely, the forward and backward local main paths, the global main path, and the key-route main path (see Figures 4-7). In generated networks, each node represents an article and is marked with the information related to the lead author and the publication year. The link represents the pattern of knowledge flow, and the thicker the link, the more important it is.

5.1. The citation networks

The entire citation network is presented in Figure 8. The network consisted of 253 nodes and 844 edges. Three types of nodes existed. The first type represented the nodes located in the largest subnet, in which 204 nodes were closely connected. These nodes constituted the core of the entire network. In the next sections, the main paths discussed were retrieved from this subset since it maintained the most citation relationships amongst the articles to the fullest degree. The second type of nodes were those with few citations. These nodes were linked with other nodes in the network and distributed at the periphery of the network. The third type consisted of isolated nodes that were not linked with any node in the citation network.

5.2. The location main paths

Figures 4 and 5 depict the local main paths, containing 34 articles and 12 articles, respectively. In total, 8 common articles appeared on both paths, whilst the nodes coloured in green were the different ones.

It is evident that Tieman (2011) and Tieman, van der Vorst, and Che Ghazali (2012) were the first articles on both paths, marking the initial development of the HF research domain. In the former, the author described the essential requirements of the HF supply chains to ensure the HF integrity at the point of consumption. It was found that HF supply chains are required to avoid direct contact with prohibited materials, reduce contamination risk, and improve Muslim consumers' perceptions of HF. In the second article, Tieman, van der Vorst, and Che Ghazali (2012) proposed a new framework to optimise the design of the HF supply chains. The conceptualisation of HF was further examined by Tieman (2015b), who introduced the concept of a halal cluster to organise HF production and trade better. In Zailani, *et al.* (2015), the authors investigated the drivers that encourage HF firms in Malaysia to adopt a halal orientation strategy. It was found that the halal market demand, government support, expected business benefits, and integrity influence halal orientation strategy positively.

The backward local main path exposed three different studies at the beginning of the path. These included Nasir, *et al.* (2011), in which the authors developed an RFID-based validation system for HF. Through this system, it is possible to authenticate and validate a halal logo issued by a regulatory body. In Nakysinsig, *et al.* (2012), an overview of the possible analytical techniques for HF authentication was provided, emphasising the authenticity issues of HF and the need to ensure a quick, reliable, and cost-efficient method to HF authentication. van der Spiegel, *et al.* (2012) discussed halal requirements, applied standards, and certification, and the role of audits and laboratory analysis in the verification of HF certificates.

After the studies of Tieman, van der Vorst, and Che Ghazali (2012) and Zailani, *et al.* (2015), the forward local main path began to be significantly different from the backward local main

path. The forward local main path diverged into two major paths. The first divergence part was at the study of Tieman and Hassan (2015), who examined the importance of religious food laws in providing answers to current issues facing the food systems. Following the authors, the existing industry practices lacked sustainability and did not comply with religious scriptures, including Islamic law. One year later, Demirci, Soon, and Wallace (2016) reviewed the issues related to food safety in halal assurance and concluded that several areas still needed further research, such as the perceptions of non-Muslim nations and manufacturers on halal assurance and the ways to ensure HF safety in Muslim-majority countries. In Soon, *et al.* (2017), a definition of halal integrity was developed using farm to fork and global supply chain models. It also argued that halal integrity lies in clearly providing the details of the halal status of food products and ensuring that the conditions for halal are met.

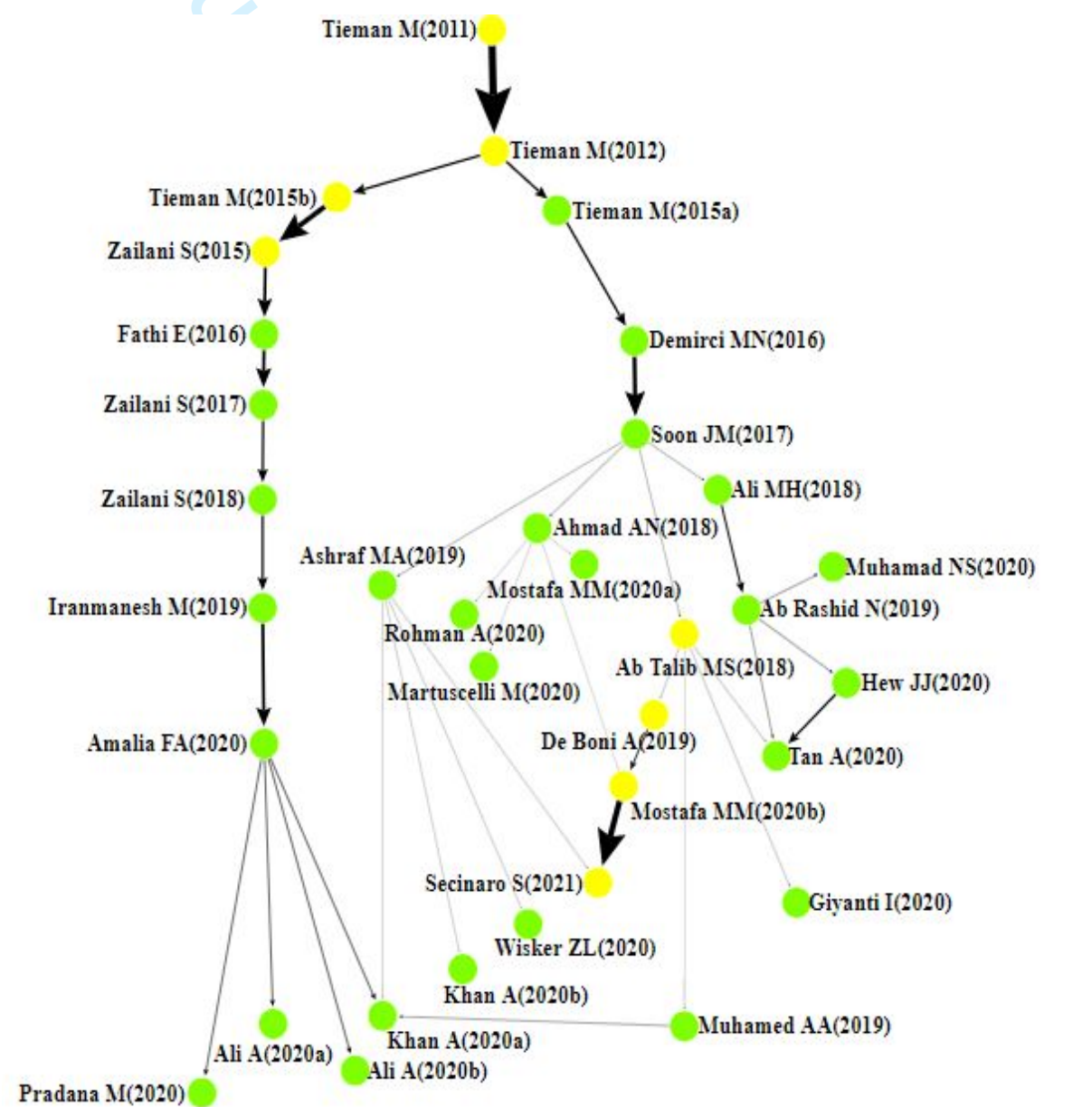


Figure 4. Forward local main path

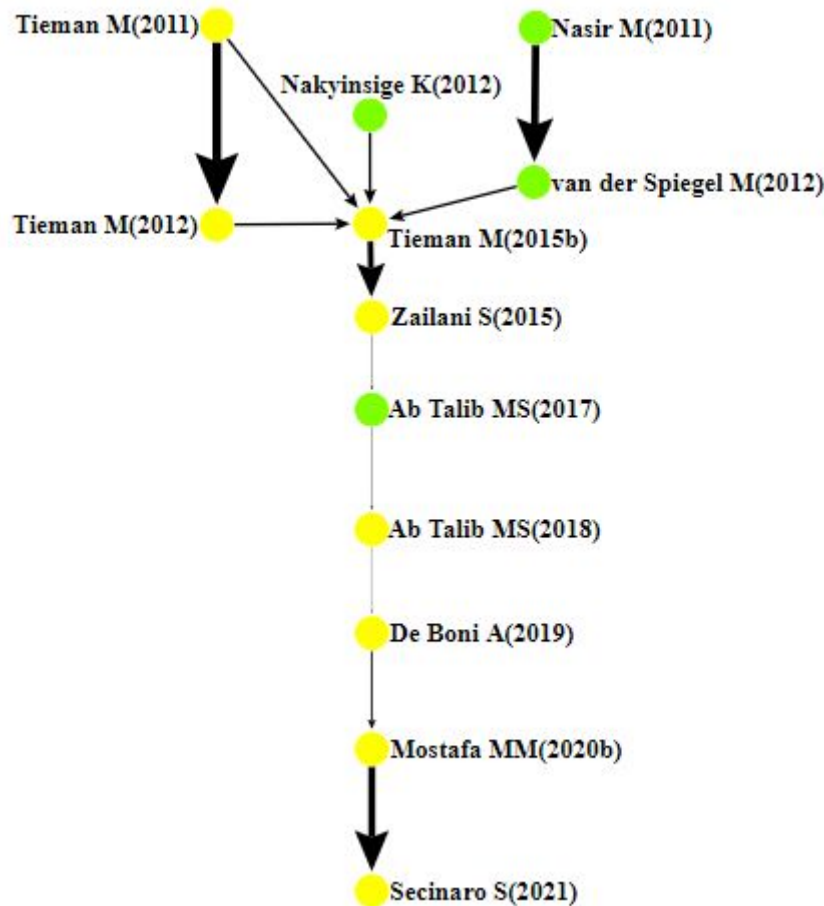


Figure 5. Backward local main path

Research emerging from the study of Soon, Chandia, and Regenstein (2017) has become more prosperous. At the beginning of the first path, two papers, Ali and Suleiman (2018) and Ab Rashid and Bojei (2019), argued that halal integrity is challenging to assure due to supply chain complexities, food fraud, and inadequacy of standard regulations. More recently, however, researchers have advocated the potentials of blockchain technology for strengthening HF integrity, facilitating HF traceability, and promoting transparency (Hew, *et al.*, 2020; Tan, Gligor, & Ngah, 2020).

After Soon, Chandia, and Regenstein (2017), the two local main paths merged again to Ab Talib and Ai Chin (2018). In this paper, the authors studied the causes behind HF standards implementation amongst Malaysian food manufacturers using a sample survey of 210 halal-food manufacturers. The results of the empirical investigation reveal that the internal reasons for the implementation of the HF standards were firm's commitment, operational improvement, and marketing function; meanwhile, the external reasons included government intervention and consumer pressure. In De Boni and Forleo (2019), the trends and opportunities for the development of a halal market for Italian foods were examined, and the findings point to several challenges hampering the adoption of strategies in non-Islamic settings such as the institutional context, lack of awareness of halal principles, and hesitance to consume HF. The following two papers, Mostafa (2020b) and Secinaro and Calandra (2020), made a review of HF research using bibliometric techniques to identify the influential authors, journals, collaboration patterns, and emerging research trends. Whilst these studies have contributed to shed light on the intellectual structure of HF research, they did not examine the knowledge diffusion of this research area.

Based on the previous research, the last two papers which appeared on the path were Muhamed, *et al.* (2019) and Giyanti, *et al.* (2020). In the first paper, the authors examined the impact of halal concern and the emotional and epistemic value on consumer behaviour during the choice and purchase of certified HF supplies. The next year, guided by the study of Ab Talib and Ai Chin (2018), Giyanti, *et al.* (2020) analysed the drivers of halal standards implementation in the HF manufacturing small and medium-sized enterprises (SMEs) and concluded that internal motivation and firm commitment have a positive impact on halal standards implementation.

The third branch consisted of four primary studies. Ahmad, *et al.* (2018) explained the system for HF control in Malaysia considering five essential elements for an effective national food control system: HF legislation, and HF management control, inspection, laboratory, and education. Later, two papers, Martuscelli, *et al.* (2020) and Rohman and Windarsih (2020), provided reviews of the analytical authentication methods of HF. Beyond the scope of these studies, Mostafa (2020) explored the structure, interaction patterns, opinion leaders, and communities' distribution of players engaged in cross-national HF Twitter networks. The author's findings highlighted the relational nature of HF networks and the value of social media as a critical communication tool in the international marketing of HF.

The fourth branch comprised the paper of Ashraf (2019) from which four papers emerged. In Ashraf (2019), an attempt was made to investigate consumer behaviour toward HF purchases in Bangladesh, and the results indicated that trustworthiness, attitudes, normative structure, and self-efficacy significantly determined HF purchasing. Exploring the ways consumers process and react to fake news on HF, Wisker (2020) found that religiosity moderates the relationships between anger and brand hate. Like Wisker's (2020) study, Khan, Arafat, and Azam (2020) assessed the impact of religiosity and halal literacy on the intentions of Muslim consumers to buy HF products in India. Lastly, Khan, Mohammad, and Muhammad (2020) developed and tested an integrated framework of brand love and experience in the HF industry. The study's findings support the fact that brand experience is a critical determinant of HF's brand love.

The second major divergence part was at the study of Tieman (2015b), followed by Zailani *et al.* (2015). After these two papers, Fathi, *et al.* (2016) looked at the drivers that motivate the willingness of consumers in Malaysia to pay for halal logistics and its impacts on their demand for halal logistics certification. Later on the path, Zailani, *et al.* (2017) examined the barriers and opportunities of halal logistics adoption in logistics firms in Malaysia. Ambiguous halal rules, scarcity of international halal certification, and insufficient collaboration amongst governing bodies were a few challenges identified from the study. In Iranmanesh, *et al.* (2019), the theory of planned behaviour was extended by self-identity and religious commitment to predict the willingness of Muslim consumers to pay for certified HF. According to the authors, these two elements positively influence consumer's willingness to pay for certified HF. The next year, Amalia, Sosianika, and Suhartanto (2020) examined the factors of Muslim Millennials' purchasing behaviour of HF in a Muslim-majority country and found that purchase intention and habit can independently influence their purchasing behaviour.

Research at the end of the path became more diversified. For instance, Pradana, *et al.* (2020) explored the purchase intention of HF in Spain amongst Muslim students and found that the halal credence factor constituted a critical determinant influencing attitude towards halal and purchase intention. Moreover, Ali, *et al.* (2020a) realised that the halal brand image has an important and positive impact on the halal brand perceived quality, satisfaction, trust, and loyalty. In another study, Ali, *et al.* (2020) investigated the drivers of halal meat consumption within the Chinese and German Muslim populations employing the theory of planned

behaviour. The findings suggest that the intention of HF consumption is determined by personal attitude toward halal meat consumption, desire to comply with others, perceived control over halal meat consumption, and food availability.

5.3. The global main path

As opposed to the two previous local paths, which aimed to concentrate on identifying the most influential links in the citation network, the global main path determined the overall most significant path. Overall, this path contained 13 influential papers as shown in Figure 6. The SPC values of all citation links on this path are summarised in Table 3. It is obvious that the link from Tieman (2011) to Tieman, *et al.* (2012) had the largest SCP value, followed by the link from Tieman (2015b) to Zailani, *et al.* (2015) and the link from Fathi, *et al.* (2016) to Zailani, *et al.* (2017). Moreover, the link emerging from Iranmanesh, *et al.* (2019) to Amalia, Sosianika, and Suhartanto (2020) had the highest SCP value amongst the citation links at the end of the path. These studies shared similar findings in that the purchasing of HF was determined by a set of factors, including self-identity, religiosity, and behaviour.

At the beginning of the global main path, the links were much thicker than the links at the end of the citation chain, suggesting that earlier published articles garnered more attention and recognition than the articles at the end of the path. Nevertheless, the appearance of those articles at the top of the path indicates the significance of these followers in the main path. Therefore, the position of these articles needs to be verified over time as more articles continue to come out.

Table 3. The SPC values of the citation links on the global main path

| Links | SPC | Ranking |
|---------------------------------------|------|---------|
| Tieman M (2011)->Tieman M (2012) | 1029 | 1 |
| Tieman M (2012)->Tieman M(2015b) | 297 | 6 |
| Tieman M(2015b)->Zailani S (2015) | 672 | 2 |
| Zailani S (2015)->Fathi E (2016) | 414 | 5 |
| Fathi E (2016)->Zailani S (2017) | 435 | 3 |
| Zailani S (2017)->Zailani S (2018) | 297 | 6 |
| Zailani S (2018)->Iranmanesh M (2019) | 294 | 8 |
| Iranmanesh M (2019)->Amalia FA (2020) | 420 | 4 |
| Amalia FA (2020)->Pradana M (2020) | 148 | 9 |
| Amalia FA (2020)->Ali A(2020a) | 148 | 9 |
| Amalia FA (2020)->Khan A(2020a) | 148 | 9 |
| Amalia FA (2020)->Ali A(2020b) | 148 | 9 |

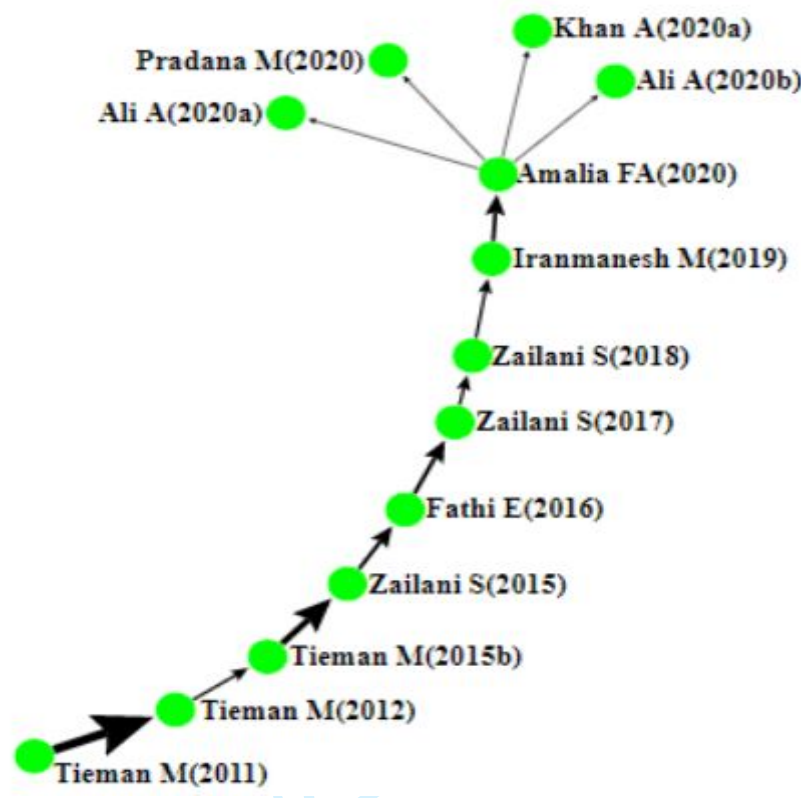


Figure 6. Global main path

5.4. The key-route main path

The analysis of the key-route main path helped the researcher to find more details about the development of the HF domain. As opposed to the local and global main paths, the key-route main path depicted more comprehensive knowledge diffusions in the HF domain. This article chose the number of key-routes with a step size 5 and ultimately selected 20 for the best result. Figure 7 shows the key-route main path comprising 30 relevant articles. It is obvious that there have been several significant streams of the development of HF over the past decade. At the beginning of the main path, the routes highlighted in grey were similar to the first half of the backward local main path. On the right side, the path highlighted in yellow was similar to the global main path, whereas, on the left side, all articles on the orange path were more like the articles on the forward local main path.

The rest of the papers have not appeared on the above previous paths. In Ali and Suleiman (2016), the relationships between standard food practices and sustainable production principles were investigated in HF Malaysian producers. The findings suggest that HF shared some similarities with organic food in that both emphasised health and sustainability. The next paper on the same path was Ali, *et al.* (2017), where the authors developed a HF supply chain integrity framework consisting of four dimensions, comprising raw material, production, service, and information. The subsequent paper, Tan, *et al.* (2017), examined the influence of external integration on HF integrity or compliance with halal standards. At the end of the left side, a trend to diversify the extant research is noticed. For instance, Ahmad, *et al.* (2017) tried to determine the critical factors for effective implementation of a HF management system in small and medium enterprises and found that the top management, employees, information and knowledge, policy and procedure, and training represented important success factors for the implementation of this system. Furthermore, Mostafa (2018) identified a knowledge gap

pertaining to sentiments towards HF on social media, and analysed a random sample of 100000 tweets discussing HF. The findings indicate that there were positive sentiments toward HF and efforts to use digital posts to communicate about HF. Likewise, the next paper on the route, Bashir (2019), sought to reveal the drivers that influence foreign consumers' purchase intentions toward HF purchasing behaviour in South Africa and confirmed that halal awareness, logo, and attitude significantly shaped the HF purchase intentions and behaviours. The focus of the last paper, Kwag and Ko (2019), was strikingly different from the other papers in that the authors tried to optimise the location and allocation of the HF logistics network by developing a mathematical model reflecting the chain effect from Haram facilities. In summary, the new papers appearing in the key-route main path gathered at the study of Mostafa (2020b), which reviewed the entire HF domain using bibliometrics.

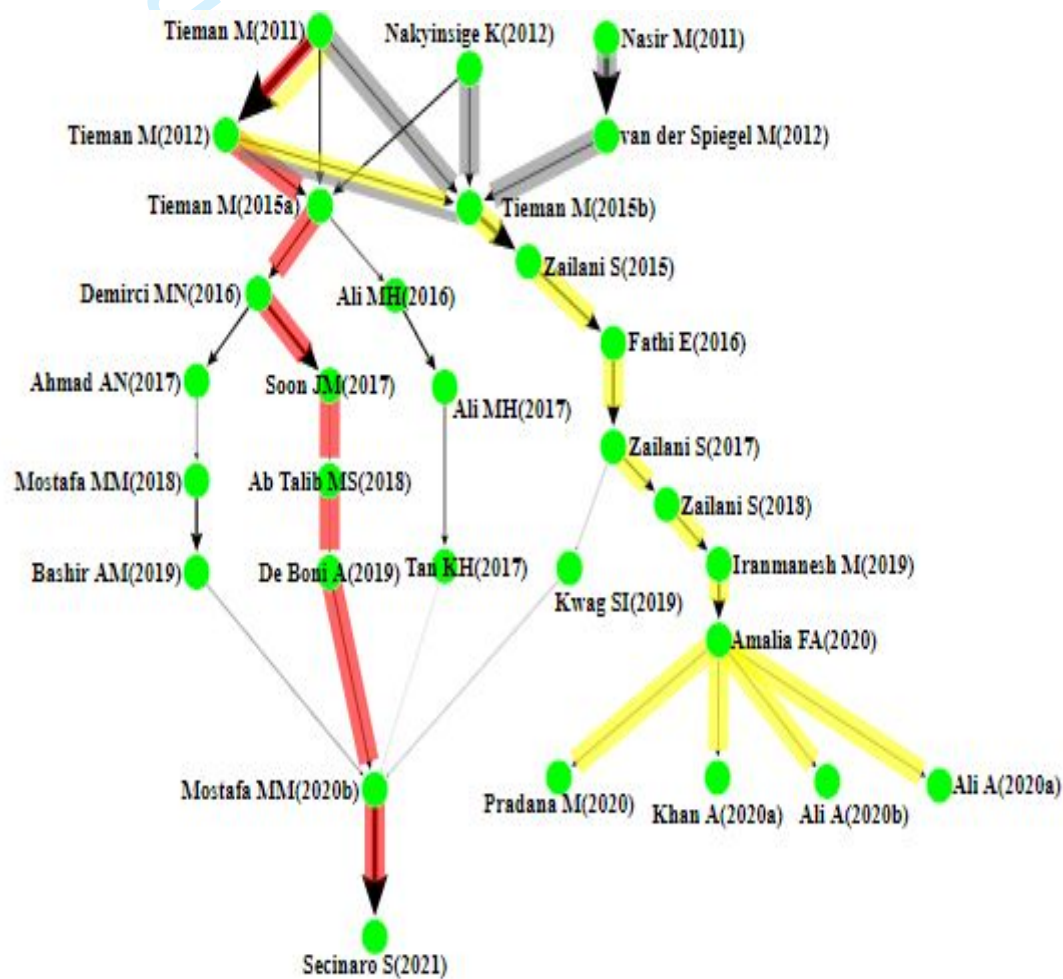


Figure 7. Key-route global main path

6. Discussion

This study has analysed the research topics discussed in the HF domain based on the keyword co-occurrence network and a citation network of 253 papers discussing HF. Considering the largest subnet, four types of main paths were generated to reveal the knowledge diffusion trajectories of the HF field from different perspectives. The historical reconstruction of the HF domain has been visualised and presented based on the analysis of the local main paths. Furthermore, the global main path was employed to identify the overall most influential path,

followed by the key-route main path, which revealed the development structure of the HF domain in a comprehensive manner.

6.1. Major findings

The major findings as concluded from the keyword co-occurrence network analysis and MPA can be summarised as follows.

1) The keyword co-occurrence network analysis results suggest that the HF literature centres mainly on several aspects, such as HF safety and trust, attitudes towards HF purchasing, halal certification, HF supply chain management, marketing, etc. This finding is congruent with the studies conducted by Mostafa (2020) and Secinaro and Calandra (2020), which reported that HF mainly deals with HF safety and trust, halal certification issues, and Muslim consumers' attitudes towards the purchase and logistics of HF products. A few studies also found that there is a substantial and positive impact between trust in Muslim food sellers with attitudes and interests in purchasing halal products (Ahmed, 2008; Verbeke, *et al.*, 2013). Ashraf (2019) demonstrated that like normative structure and self-efficacy, trust in the authenticity of HF is especially significant to impact attitude toward HF buying in Bangladesh. Therefore, establishing confidence amongst HF consumers is vital since the aspect of trust impacts their purchasing decisions (Botonaki, *et al.*, 2006). However, achieving trust in HF products demands distinctness in certifications, which can be realised by generally accepted standards and halal assurance systems (Muhammed, *et al.*, 2019). Overall, studies about HF safety, trust, and certification occupy a significant percentage. As food safety has become a critical concern worldwide, HF supply chain partners are required to maintain effective measures and practices to enhance HF safety and increase consumer trust in HF. This is crucial as Giyanti, *et al.* (2020) noted that the adoption of quality and food safety standards, including halal standards, is aimed to prevent numerous issues such as safety and health problems, product failures, consumer dissatisfaction, and failure costs (van der Spiegel, *et al.*, 2007). Related terms found in the keyword co-occurrence network included halal, trust, consumer behaviour, certification, etc.

2) Considering the complexity of HF production, articles about HF supply chain management, logistics, and marketing have significantly attracted scholars' attention. This finding is in line with Rejeb, *et al.* (2021), who believed that HF supply chain management poses extra considerations surrounding the ways HF is prepared, handled, transported, and delivered to consumers. Abdullah, *et al.* (2018) argued that the intricacies and sensitivities of HF supply chain activities (e.g., processing, logistics, storage) require a different and novel approach for addressing sustainability. From the marketing perspective, the current study identifies that HF positioning, branding, packaging, and labeling are topical themes in the literature. According to Ab Talib (2017), HF firms need to re-establish their market by applying halal certification to cater to the growing Muslims' demands for HF and gain better marketing positioning. Moreover, the recognition of halal as a brand (Wilson and Liu, 2010) contributes to the growth of the HF industry. In other words, HF businesses are urged to restructure their strategies to reach consumers by applying effective branding and appealing packaging for their HF products. Therefore, the current study agrees with the findings of Bashir (2019), who recommended that HF producers and marketers use halal logos, especially when they strive to promote their HF products. Branding food products with halal logos not only helps to increase competitive advantage (Ashraf, 2019) but also to symbolise both trust and quality for HF consumers (Mostafa, 2018).

3) More recently, assurance of HF integrity and safety using new technologies such as blockchain and the internet of things is an emerging research area that has been of scholars' interest. This finding is consistent with the recent studies of Ali, *et al.* (2021); Secinaro and Calandra (2020); Tan, *et al.* (2020); and Hew, *et al.* (2020), who believed that the integration of blockchain technology in HF supply chains is a developing research area that requires additional empirical studies. Further, these authors called for more research investigating the impact of this cutting-edge technology on the performance of HF supply chains, the costs, and benefits of blockchains, the adaptability of blockchains to the Islamic context, and the potential of blockchain-enabled HF supply chains to reduce cross-contamination risks and facilitate data sharing between companies and consumers. The current study corroborates the previous literature (e.g., Rejeb, 2018; Rejeb, Rejeb, Zailani, *et al.*, 2021; and Tieman and Darun, 2017), which demonstrated the role of the Internet of Things and its combination with blockchain technology to facilitate HF traceability, improve HF supply chain efficiencies, optimise livestock management, authenticate HF status, and monitor halal certifications.

4) The analysis finds that most of the papers discuss HF within consumer behaviour and attitudes. For instance, Ahmadova and Aliyev (2020) studied Muslims' drivers to purchase halal products, Sherwani, *et al.* (2018) studied Muslims' attitudes in Turkey and Germany on the halal meat consumption, and Bonne, *et al.* (2007) studied the attitude of Muslims in France towards the consumption of halal meat. All these research areas are strictly connected and show that HF consumption serves as another area which has shifted from investigating the drivers and barriers of adopting halal logistics to examining the impact of consumer attitude, norms, and behaviour on HF purchase consumption. In a society increasingly committed to addressing food security and food safety, these may be important aspects that explain the consumer behaviour and attitude toward HF. Nevertheless, there are no studies that have examined the attitudes and behaviours of the people that engaged in the HF production. People or human capital is best defined as a key element in improving firm assets and employees to increase productivity as well as sustain competitive advantage (Marimuthu, *et al.*, 2009). Human capital also refers to processes that relate to training, education, and other professional initiatives to increase the levels of knowledge, skills, abilities, values, and social assets of an employee which will lead to the employee's satisfaction and performance, and eventually on firm performance. Nowadays, to make fast entry into the global HF market, the human resource that can facilitate knowledge and expertise on halal is principally important (Nik Muhammad, *et al.*, 2009; Shariff, *et al.*, 2016). Shariff, *et al.* (2016) claimed that one of the problems raised by previous halal research is the lack of halal awareness and understanding amongst the workforce in the halal industry. Hence, this study concurred with Shariff, *et al.* (2016) that researchers need to investigate the contribution of halal awareness and understanding amongst the workforce in HF.

5) The findings from our review shows that only a few papers discussed sustainability within HF, amongst them were Rezai, *et al.* (2015) and Ali and Suleiman (2016), which examined the relationships between sustainable production in the HF industry amongst Malaysian producers. However, there are lots of papers which have discussed sustainability on the food and beverage sector (Bollani, *et al.*, 2019; Franceschelli, *et al.*, 2018; and Nirino, *et al.*, 2019). It is noted that the public are now concerned with climate challenges, therefore, areas such as the consumers' perceptions of the sustainability of HF products, the role of Islam in increasing sustainable production, how companies that produce HF sustainably transform their processes, the effect of an increase in demand for quality as well as sustainable HF, and how climate change will affect HF, need to be researched more in-depth in the future. As recommended by Ali and

Suleiman (2016), an in-depth understanding on the elements of sustainability in HF may provide valuable insights for development of sustainable programmes in the HF industry.

6.2. Future directions

Based on the previous analyses, this study suggests future research directions for HF.

- 1) There is a need to conduct empirical and quantitative studies to test and evaluate the motivation and opportunities of HF strategies. Testing the drivers of applying HF processes in different geographic contexts will enable a deeper understanding of the performance of HF products in the market. The intention to integrate new business models, systems, and technologies can be investigated through models that comprise different management theories, such as the institutional theory, resource-based theory, and diffusion of innovation theory. In the future, studies should attempt to develop a theoretical framework by incorporating these theories into drivers of adopting the halal concept. Scholars can focus on more comprehensive frameworks to understand HF production and consumption behaviour.
- 2) Future work should focus on the role of different demographic factors like age, educational level, country of origin, and income to influence HF (Ali, *et al.*, 2020b). Similarly, the extent to which religiosity impacts on consumers' opinions regarding animal welfare, slaughter, and prayer methods, and the information required for HF identification should also be investigated (White and Samuel, 2016). Therefore, it is necessary to enrich HF research and illuminate consumer attitudes towards HF, confidence in HF labelling, and HF product-specific information seeking (Bonne and Verbeke, 2007).
- 3) Challenges concerning halal certification involving health, organic, environmentally sustainable, cruelty-free animal welfare, ethical, and fair-trade attributes have made the concept of halal popular and highly appreciated by all societies (Rohman and Windarsih, 2020). Thus, it is recommended to investigate to what extent the organic and functional added value attributes can be integrated in HF products. Currently, there is a lack of studies that examine the impact of health-related labelling on HF. With this regard, more attention needs to be given to the sustainable development of HF supply chains and logistics.
- 4) The integration of big data, the Internet of Things, and blockchains is expected to provide new prospects and challenges for the future development of HF supply chains. For example, Secinaro and Calandra (2020) argued that the use of big data helps to analyse the decision-making process of HF manufacturers. The traceability, immutability, and security features of blockchains have the potential to improve HF processes (Hew, *et al.*, 2020; Tan, Gligor, & Ngah, 2020). Under this context, incorporating new technologies into the HF supply chain needs to be investigated in the future.

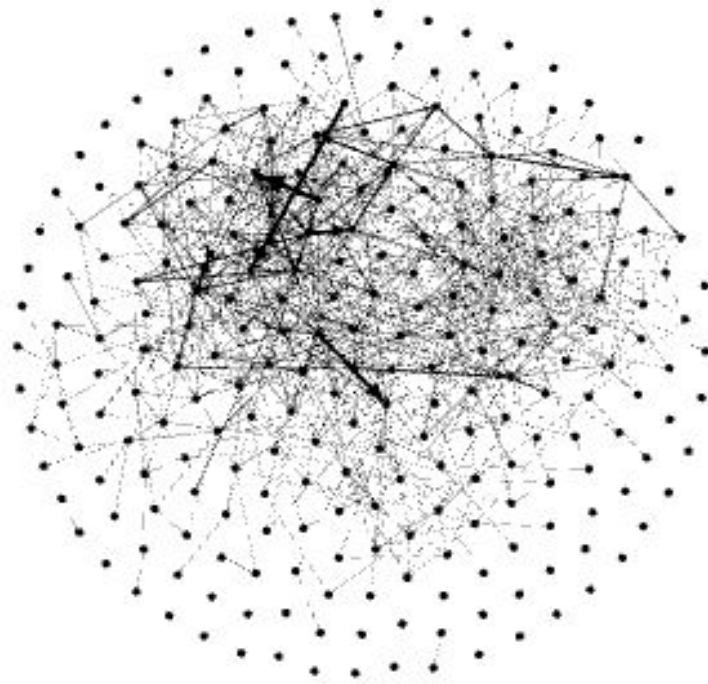


Figure 8. The entire citation network of the selected sample

6.3. Future potential subject areas

Research on HF has attracted significant attention from different fields. To identify which subject areas are allocating attention to the HF domain, the selected sample of 253 articles was analysed. Table 4 presents the subject areas according to the number of articles. The articles in the field of business, as well as food science and technology, occupied a high percentage, representing more than 58% of the total selected articles. The attention from these two subject areas has risen over the years, and it is expected that scholars will continue to study HF from the business and food science perspectives. Moreover, there were some publications from other subject areas, such as agricultural economics and policy (8.66%), management (5.07%), hospitality, leisure, sport, and tourism (4.48%), and religion (3.58%). Although HF research was penetrating the business and management subject areas, there is a need for contributions from engineering and computer-related subject areas.

Table 4. Number of articles according to subject areas

| Subject | TP | % |
|---------------------------------------|----|--------|
| Business | 82 | 24.48% |
| Food Science & Technology | 66 | 19.70% |
| Agricultural Economics & Policy | 29 | 8.66% |
| Management | 17 | 5.07% |
| Hospitality, Leisure, Sport & Tourism | 15 | 4.48% |
| Religion | 12 | 3.58% |
| Agriculture, Multidisciplinary | 9 | 2.69% |

| | | |
|-------------------------|---|-------|
| Social Sciences, | 9 | 2.69% |
| Interdisciplinary | | |
| Sociology | 6 | 1.79% |
| Economics | 5 | 1.49% |
| Veterinary Sciences | 5 | 1.49% |
| Engineering, Industrial | 5 | 1.49% |
| Chemistry, Analytical | 4 | 1.19% |
| Environmental Sciences | 4 | 1.19% |
| Environmental Studies | 4 | 1.19% |
| Chemistry, Applied | 4 | 1.19% |

7. Conclusions

As a basic need for Muslim consumers, HF has attracted significant attention from scholars and practitioners alike. With the increasing attention being paid to the HF literature in the last decade, it is essential to examine the HF domain comprehensively and systematically and offer valuable insights for future research. Using a sample of 253 articles selected from the Web of Science database during the period 1970-2020, this study employed quantitative methods, namely, the keyword co-occurrence network analysis and the MPA to reveal the main topics, influential articles shaping the HF development, and knowledge diffusion trajectories and genealogy over the past decade through the analysis of local (forward and backward), global, and key-route main paths.

The analysis of keyword co-occurrence network reveals that HF safety, trust, certification, and supply chain management were the most popular topics in the HF domain. Besides that, the local main paths depict the dynamic development of HF domain in a comprehensive manner, implying that HF research has shifted from the business perspective to the consumer perspective over the studied period. The global main path shows that links from Tieman (2011) to Tieman, *et al.* (2012) and Tieman (2015b) to Zailani, *et al.* (2015) had the highest SPC values, which were the most important connections in the HF domain. Further, the key-route main path showed the knowledge transmission routes in the formation of this domain.

To the best of our knowledge, no studies have yet employed the MPA to examine the knowledge diffusion routes of the HF research area. The use of four types of main paths indicates the dynamic formation process of HF research from different perspectives, providing deep insights for scholars to improve their understanding of the HF research over the past ten years. Unlike conventional review methods and bibliometric studies, this paper offers novel ideas for analysing the HF domain. First, the use of this quantitative method will help scholars identify critical topics in the history of HF and unravel the routes of knowledge dissemination comprehensively, which are determined easily. Second, several research directions are suggested, inspiring the researchers to carry out their projects in an intuitive way. This paper gives a clear evolutionary structure of the HF domain, which will be helpful for new researchers who are considering entering the HF research field.

Despite its significant contributions, this paper has some limitations, although we have done our best to make the dataset for analysis as accurate as possible. For instance, the database used to select articles for this paper was only the Web of Science. The study would have been more robust if it considered other academic databases such as Scopus and Google Scholar. Moreover, by using the search keyword “halal food”, these study findings are insightful and informative for determining the future directions in the HF literature. However, it would be better to use

additional keywords related to HF (e.g., halal restaurant, halal meat) to maximise the inclusion of all potentially relevant studies to the HF topic. The sample of these articles represents a small part of the total papers published on HF. Over time, it is foreseeable that the findings of the MPA may change if new articles are published and poured into academia. In addition, this paper overlooks the relative importance between the citing and cited articles. The importance between them is taken to be the same, which is not the case. In fact, we may have missed some related papers not indexed in the Web of Science. Thus, the importance and impact of the articles in the citation network should be considered in future research. The researcher believes that the nature of the methodology adopted will leave only a small insignificant error in the dataset for the analysis of results and that the main paths explored are representative of the knowledge diffusion routes for the HF domain. In the future, studies can combine different clustering algorithms with the MPA to investigate different flows of knowledge dissemination in diverse aspects in the HF field.

In summary, this paper has presented a unique approach for investigating the knowledge diffusion structure of a developed academic field by analysing the main paths. It is not only appropriate for the study of HF, but it is also helpful for many other research topics.

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