

Research Hotspots on Fresh Cold Chain Logistics Based on CiteSpace

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Abstract: With the rapid development of today's logistics industry, fresh cold chain logistics, as one of the important branches of the logistics industry, is an important means to ensure the quality and safety of fresh products, and its development has attracted more and more attention. In this paper, 181 papers related to fresh cold chain in Chinese core journals and CSSCI journals from 1998 to 2023 in CNKI database were taken as research objects, and the methods of keyword co-occurrence map, cluster map, and emergent word detection provided by visualization software CiteSpace were used to sort out and summarize the collected data, and explore the research hotspots and frontiers in the field of logistics process of fresh cold chain products. At the same time, China's agricultural product cold chain logistics research groups are in a fragmented state, and distribution mode and fresh e-commerce are the current hot spots of agricultural product cold chain logistics research; At present, there are still problems such as long supply chain, many circulation links, high cost and loss in the cold chain logistics of agricultural products, and in-depth discussions should be carried out from the aspects of intelligent logistics and cold chain logistics in the future.

Keywords: Fresh cold chain logistics, CiteSpace software, Visual analytics.

1. Introduction

With the rapid development of the domestic economy and the improvement of people's living standards, people's demand for fresh food is increasing, and the quality of fresh products is also higher [1]. At the same time, thanks to the substantial growth of market demand for cold chain products such as meat, fruits, vegetables, aquatic products, and biological agents in China, cold chain logistics has achieved rapid development and has become one of the emerging industries, and is gradually becoming an important means to solve the problem of fresh food preservation and transportation. As early as 2017, the State Council issued Document No. 29 pointed out that the cold chain logistics industry due to a late start, weak foundation, imperfect standard system, relatively backward infrastructure, low level of specialization and other problems, proposed to improve the cold chain logistics standards and service specification system, improve the cold chain logistics infrastructure network, accelerate the innovation and application of cold chain logistics technology and equipment. Especially in the past two years, national policies have also been frequently introduced, such as the National Development and Reform Commission in 2022 issued the "National Backbone Cold Chain Logistics Base Construction Implementation Plan", and in 2022, the Supply and Marketing Cooperatives issued the "National Supply and Marketing Cooperatives "14th Five-Year Plan" Special Plan for the Development of Public Agricultural Products Cold Chain Logistics, these documents have laid a solid policy support for the further development of cold chain logistics. Although there are many research literatures on fresh cold chain in China, most of them focus on some local problems of fresh cold chain, and most of them are qualitative research, which is difficult to comprehensively and intuitively show the research dynamics and research hotspots in the field of fresh cold chain.

In order to fully understand the research trends in the field of cold chain logistics, this paper is based on 181 relevant

literature in CNKI from 1998 to 2023 in Chinese core journals and CSSCI journals, using CiteSpace software for visual analysis, exploring the research characteristics, research hotspots, development history and frontier trends of existing literature in the field of cold chain logistics, integrating keyword co-occurrence, clustering, timeline, time zone map and other maps, as well as mutation rate detection. The purpose of this analysis is to gain an in-depth understanding of the hot issues and frontier issues in the logistics process of domestic agricultural products, the development trend of the logistics process of agricultural products in the future, and to provide ideas for further research on the logistics process of agricultural products.

2. Data Sources and Methodology

2.1. Research Tools & Methods

CiteSpace is an intuitive chemical tool developed by Prof. Chaomei Chen's team to identify scientific literature, showing the development process of scientific knowledge systems and the relationship between them [2]. The main idea of the software is to use the "co-occurrence clustering" technology to extract the information units in the scientific literature, and reconstruct them according to the type and intensity of the connection between the information units to form a series of scientific knowledge graphs. In this study, we discussed the research hotspots, evolution trends and research frontiers of domestic scholars in the field of fresh cold chain logistics through keyword co-occurrence analysis and burst detection. On the parameter selection, the time slice is set to one year, while the threshold and other settings are the defaults.

2.2. Data source

In order to ensure the reliability of the research literature, the research data of this paper are from CNKI (CNKI), with the theme of "fresh cold chain" for search, the search time is published from 1998 to 2023, the literature type is 181 fresh cold chain related literature in Chinese core journals and

CSSCI journals, and the literature needs to be exported and saved according to the format of CiteSpace, as the sample database for the research and analysis of this paper.

2.3. Data analysis

2.3.1. Overview of the study

The temporal variation of research publications can reflect the research situation in a certain period of time in the research field, which is an important indicator of the development of the research field. Figure 1 counts the publication date and quantity of literature related to fresh cold chain logistics, and divides it into two research development stages.

As for the research topic of "cold chain fresh logistics", it has attracted the attention of scholars from all walks of life as early as the last century, but it started late in China, and before 2015, there were only a handful of domestic research results in this field, so it is considered that 1998-2012 is the initial research stage in this field.

The second stage is from 2015 to the present, since 2015, the number of domestic publications has increased significantly, although the fluctuation is large, but the overall number of publications is still relatively optimistic, which shows that with the emerging topic of "cold chain logistics" in China gradually received a certain degree of attention from scholars, there is a trend of forming academic hot spots.

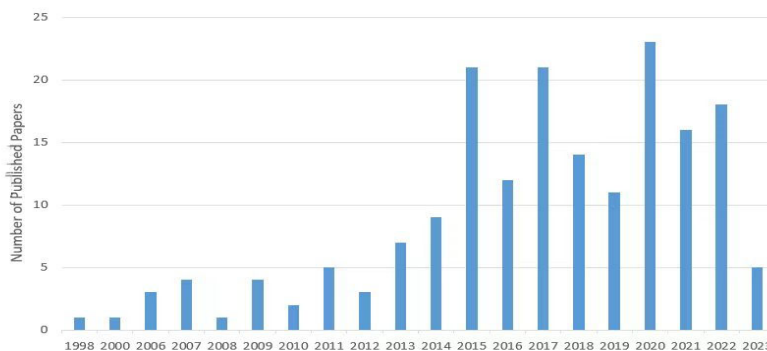


Figure 1. Annual distribution of research literature on "fresh cold chain logistics" from 1998 to 2023 (as of June 2023)

Table 1 presents information about the top 10 most cited literature in the field of fresh cold chain logistics. As can be seen from Table 1, among the 10 key literatures, only 3 used quantitative research methods, and the rest used qualitative research methods, especially the top three downloads, all of which were in 2015-2016. It can be inferred that in the past few years, the research on fresh cold chain logistics in China has focused on qualitative research (emphasizing the importance of research, the introduction of foreign theories,

domestic and foreign research reviews, and conceptual or theoretical analysis have become its main analysis contents), and its quantitative research (research with various data models) has been concentrated in these two years. And according to these 10 key literatures, it can also be seen that the research focus of China's fresh cold chain logistics is on logistics informatization, path optimization, e-commerce and other aspects.

Table 1. TOP10 Research Literature on Fresh Cold Chain Logistics

Citeds (Downloads)	Title	year	Research Methods
281(8368)	Research on cold chain logistics network of fresh food	2006	Qualitative
266 (16532)	Construction of cold chain logistics system for fresh agricultural products based on Internet of Things: framework, mechanism and path	2016	Qualitative
258 (10713)	The main problems and countermeasures faced by the development of e-commerce of fresh agricultural products	2016	Qualitative
250 (13408)	Research on the current situation and development of e-commerce cold chain logistics of fresh agricultural products in China	2015	Qualitative
226 (16454)	The development trend, problems and countermeasures of China's cold chain logistics industry	2015	Qualitative
180 (6213)	Research on distribution path optimization of cold chain logistics based on hybrid ant colony algorithm	2019	Ration
176 (5248)	Research on the optimization of the distribution path of third-party cold chain logistics	2011	Ration
175 (7824)	Analysis of the current situation and development countermeasures of cold chain logistics of fresh agricultural products in China	2013	Qualitative
172 (7544)	A Study on the Fresh E-commerce Model in the United States	2014	Qualitative
156 (5500)	Research on the optimization of low-carbon distribution paths for cold chain logistics of fresh agricultural products	2018	Ration

2.4. Co-author network analysis

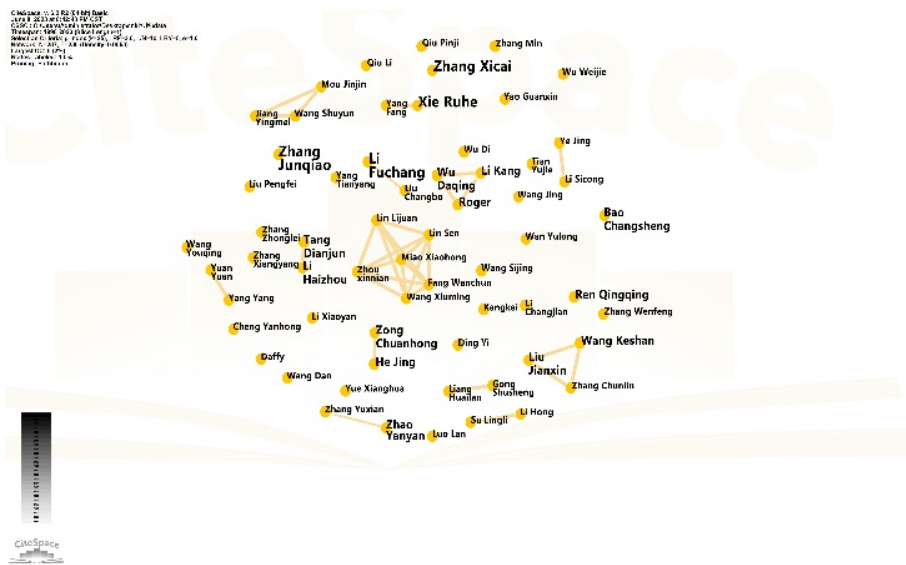


Figure 2. Scholar Relationship Network Atlas

Using CiteSpace software, 1 year was selected for time slicing, co-author was selected for node type, and other parameters were set by default, and 181 valid data from 1998 to 2023 were visually analyzed, and the relationship network graph of scholars in the field was obtained, and the results are shown in Figure 2. It can be found that there are 287 nodes and 236 connections in the figure, and the density is only 0.0058, indicating that the connection between scholars is not close enough, and the cooperation is scattered, but there are also small cooperative groups. In general, there are no influential scholars at present, and the cooperation and exchange between scholars needs to be further strengthened. In terms of the number of papers, the number of papers published is generally not high, and the more papers published, the more in-depth the author's research in a certain field, and its research methods, research angles, research contents and research results have higher reference and Xi significance, which is still relatively lacking in this aspect.

3. Visual Analysis of Hot Spots in Fresh Cold Chain Logistics

3.1. Keyword analysis

Keywords are used in academic papers to express the subject content of the literature, which can summarize the main idea of the article to a certain extent, and in general, there are 3-5 keywords in an article. Therefore, through keyword analysis in a certain field, research hotspots in that field can be identified. From the perspective of the co-occurrence frequency of keywords, the larger the circle area indicates the greater the number of co-occurrences and the higher the co-occurrence frequency [3]. Q and S values can reflect the clustering effect, and $Q > 0.3$ indicates that the clustering structure is significant, and $S > 0.7$ indicates that the clustering is convincing [4]. As can be seen from Figure 3, the Q value of the experimental data is 0.6832, indicating that the clustering is highly concentrated and has initially formed a research hotspot of a certain scale. Combined with the co-occurrence results, the research hotspots of "fresh cold chain

logistics" are summarized, mainly in the following aspects.

3.1.1. Cold chain logistics

Cold chain logistics is an "upgraded version" of modern agricultural product circulation, which has been established with the progress of science and technology and the development of refrigeration technology, and is of great significance to further promote rural revitalization in an all-round way. At the same time, the government attaches great importance to the development of fresh cold chain logistics, and actively builds a green channel framework that runs through 31 provinces, autonomous regions and municipalities directly under the central government, providing a fast and convenient main channel for the cross-regional long-distance transportation of fresh agricultural products. With the strong support of the policy, the research in the field of cold chain logistics in China has also developed rapidly in recent years.

3.1.2. Fresh e-commerce

E-commerce is an emerging industry in recent years, with its continuous improvement and development, fresh agricultural products combined with e-commerce not only expand the market channels, but also facilitate consumers to buy. However, as consumers have higher and higher requirements for food safety and quality, the fresh e-commerce market will continue to maintain rapid growth, but it will also face more challenges and opportunities.

3.1.3. Supply chain

In fresh cold chain logistics, the optimization of the supply chain is particularly important. Throughout the logistics process, from the place of production to the place of sale, it is necessary to keep the goods transported at low temperatures. By optimizing the supply chain, we can improve product quality, reduce logistics costs, and improve logistics efficiency, thereby enhancing the market competitiveness of enterprises. At present, China is in an era of economic transformation, and new technologies and new business models represented by e-commerce, big data, and Internet + have made new developments in various fields.

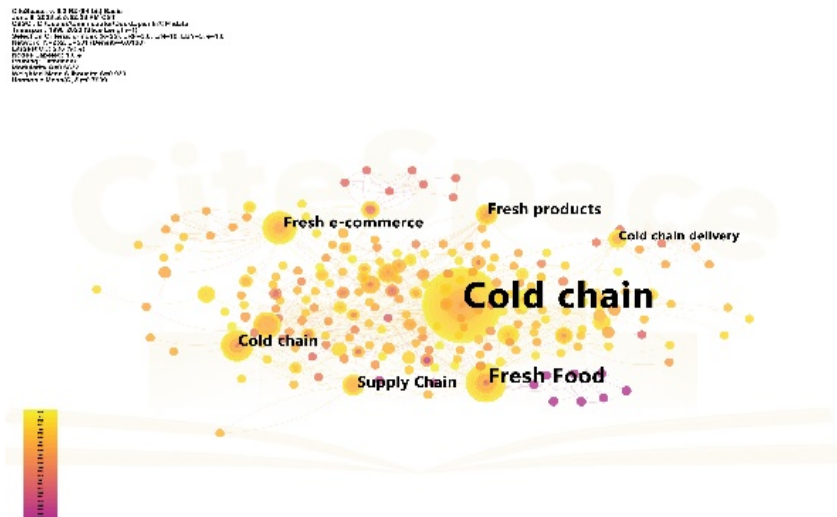


Figure 3. Keyword co-occurrence map

3.2. Cluster co-occurrence analysis

In order to have a deeper understanding of the research hotspots of the logistics process of fresh cold chain logistics, CiteSpace software was used to select 1 year for time slicing, keywords for node type, and other parameters as the default settings, and 181 effective data from 1998 to 2023 were visually analyzed, and the keyword network map in this field was obtained, and the keywords were clustered, and the results are shown in Figure 4. As can be seen from the figure, there are 252 nodes, 531 connections, and a density of 0.0168, and the keywords related to fresh cold chain logistics are concentrated in cold chain logistics, fresh food, cold chain, fresh e-commerce, cold chain distribution, carbon emissions, etc. Through the analysis of keywords, it can be roughly divided into three categories: the first type of keywords is the basic concept of cold chain logistics, such as cold chain logistics, cold chain and other basic concepts, most of which are early simple research on cold chain logistics; The second

type of keywords for the combination of cold chain logistics industry, such as fresh e-commerce reflects the combination of cold chain logistics and e-commerce industry, with the continuous improvement of the level of science and technology and the rapid development of e-commerce in China, fresh cold chain logistics is gradually developing in the direction of intelligence and informatization. The third type of keywords is combined with cold chain logistics to meet today's dual carbon strategic hot spots, such as carbon emissions, fresh products need to be kept at a low temperature in the entire logistics process, so a large amount of energy needs to be used to maintain a low temperature environment. These energy sources usually come from fossil fuels such as coal and oil, and the combustion of these fuels produces large amounts of greenhouse gases such as carbon dioxide, which leads to an increase in carbon emissions. This research hotspot is also in line with the idea of "not only gold and silver mountains, but also green waters and green mountains".

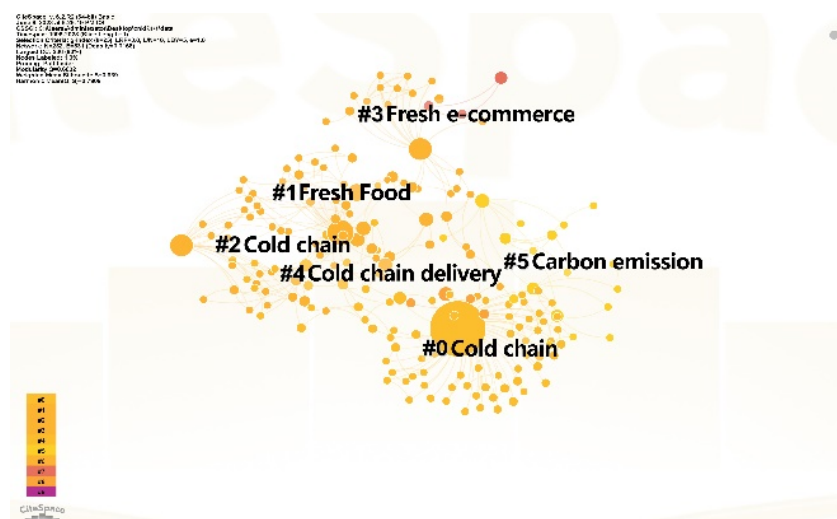


Figure 4. Keyword clustering knowledge graph

3.3. Cutting-edge analytics

Compared with ordinary high-frequency keywords, mutant words have dynamic change characteristics, which can better reflect the dynamic evolution of academic research. Keyword mutation refers to a sharp increase or decrease in the

frequency of keywords in a specific time period, which can reflect the development trend of this field [5]. The basic principle is that the frequency of a keyword will rise sharply in a short period of time, and the research heat will rise rapidly in a short period of time, and it will be detected to form a sudden hot spot, which can be used to predict the hot spot and

trend in the future. In the map, Begin represents the year in which the keyword appears, End indicates the cut-off year of the prominence, and the length of the dark area indicates the duration of the prominence period. By analyzing the mutation of keywords, we can better grasp the development trends of the field and provide guidance and reference for future research.

As can be seen from Figure 5, from 2000 to 2007, it was in the initial stage of research on the logistics process of agricultural products. After the reform and opening up, China's rural commodity economy has developed rapidly, but the fresh cold chain logistics is far behind its needs, and some scholars have begun to call for attention to the development of agricultural product logistics and logistics process. Therefore, during this period, the most intense emergent words were "status quo", "mode", "countermeasures", "development status", "food safety", etc., and the early scholars' research tended to proceed from reality, that is, to break through the obstacles of agricultural product e-commerce logistics and explore the future development mode as the main goal.

From 2010 to 2015, it was in the multi-faceted development period of agricultural product logistics process research. The research in this field has gradually shifted from macro research to micro research, and the modern logistics concept has gradually been integrated into the fresh cold chain logistics. Different scholars have begun to focus on fresh cold chain logistics for different problems. The most intense emergent words are "informatization", "agricultural products", "e-commerce", "supply chain", etc. "Informatization" has been highlighted for the longest period of 4 years, indicating that "informatization" has been a hot issue in recent years. In China, with the rapid development of information technology, the Internet has been widely used in people's daily life, online shopping has gradually become popular, and "Internet +" and related issues have gradually become the focus of people's attention.

Since 2015, this stage has been in the high-quality development period of fresh cold chain logistics. Green logistics, cold chain logistics, e-commerce, and big data have become research hotspots. The strongest words have become "e-commerce" and "supply chain", and at this stage, people's living standards continue to improve, and more attention is paid to the quality and safety of agricultural products.

Therefore, vigorously developing cold chain logistics can not only ensure the quality and safety of products, but also reduce transportation losses and meet people's needs for high-quality food. Compared with general food, agricultural products have higher requirements for quality and freshness, which puts forward higher requirements for the standardization of equipment, technology, and management of logistics enterprises [6]. Cold chain logistics and blockchain technology will continue to receive widespread attention. In recent years, the State Council has issued the "14th Five-Year Plan" for the development of cold chain logistics, which mentions that it is necessary to strengthen the application of cold chain intelligent technology and equipment, and promote the wide application of blockchain technology in the field of cold chain logistics. However, at present, China's blockchain technology is not mature, and the combination of cold chain logistics is not perfect, how to solve the existing problems in the future to achieve the upgrading of blockchain technology will be the focus of the whole society. It can be seen that blockchain technology will

be one of the cutting-edge trends in the development of cold chain logistics in the future.

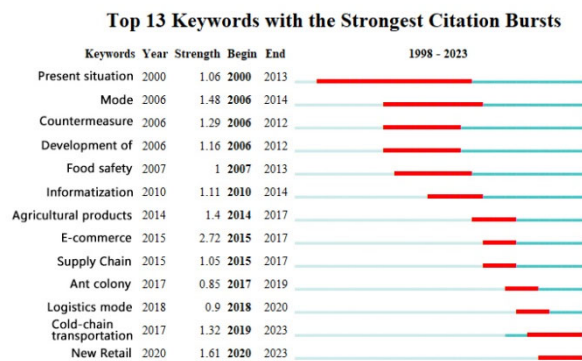


Figure 5. Keywords highlight the web

4. Conclusion

Through the analysis of 181 fresh cold chain research literature in Chinese core journals and CSSCI journals from 1998 to 2023, using the method of combining bibliometrics and atlas, through the visual analysis of the number of articles and keywords in the field of fresh cold chain, the following conclusions are mainly drawn: First, from the perspective of literature research methods, the early research mostly emphasizes the necessity and related problems of fresh cold chain logistics, and conducts qualitative research on layout planning. Later research, especially in recent years, focuses on the optimization of the logistics process of agricultural products by quantitative methods. Master's and doctoral theses are more focused on quantitative research or a combination of qualitative and quantitative research. Second, the scholars with the research theme of "cold chain logistics" are a large number of but not closely connected, although there are smaller groups of cooperation, but there is no influential scholars and research institutions, so scholars can choose to cooperate with each other in addition to independent research to further exert greater influence. Thirdly, through the analysis of keyword co-occurrence and keyword emergence, the hot issues in the stage are analyzed as the current situation, and the field of agricultural product logistics process is roughly divided into three stages: the first stage is the initial stage of the research process of fresh cold chain logistics from 2000 to 2006, which is mainly to study the integrity from a relatively macro perspective; The second stage is the multi-faceted development period of agricultural product logistics process research from 2006 to 2014, and the research in this stage gradually shifts from macro overall research to micro part research, and conducts in-depth research on the problems in some links in the process of fresh cold chain logistics. The third stage is the high-quality development of fresh cold chain logistics from 2014 to 2020, in which modern information technologies and concepts such as management systems, big data, and the Internet of Things are gradually introduced into the research of fresh cold chain logistics process, so that agricultural product logistics is gradually developing towards information modernization. Nowadays, how to promote the development of cross-border e-commerce fresh supply chain is worth further exploration, and its quality and safety, circulation cost and efficiency have not been well solved. The emergence of blockchain technology and 5G network provides a good opportunity to solve these problems, as a new type of Internet technology,

blockchain technology has gained trust and recognition around the world, and the application of blockchain technology to the field of fresh cold chain is a very promising application direction.

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