WEP Warwick Evans Publishing

International Journal of Social Sciences and Public Administration

ISSN: 3005-9836 (Print), ISSN: 3005-9585 (Online) | Volume 6, Number 3, Year 2025
DOI: https://doi.org/10.62051/ijsspa.v6n3.07
Journal homepage: https://ijsspa.org

Progress and Hotspot Analysis of Citespace-based Research on Cross-fertilization of Food and Design Disciplines

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ABSTRACT

The purpose is to comprehensively organize and assess the research progress and hotspots in the field of cross-fertilization of food and design disciplines, and to propose a future research outlook based on the current research progress. Methods Based on the journal articles in the field of cross-fertilization research in food and design disciplines included in the CKNI database as a data source, CiteSpace tool was used to draw a knowledge map from the annual number of published literature, research institutions, high-productivity authors, and co-occurrence clustering of keywords to sort out the hotspots and developmental veins. It is found that the domestic food and design cross-fertilization research is generally on the rise in terms of literature output, and has a rapid growth trend in the past 20 years; the research hotspots are mainly concentrated in four major research directions: food and experience design research, food and health design research, food and sustainable design research, and food and socio-cultural innovation and design research; the cross-fertilization of food and design in the field of AI technology and other areas of The research on food and design cross-fertilization in areas such as AI technology and sustainability is its future development direction.

KEYWORDS

Design Disciplines; Food; Visual Analytics; Citespace.

1. INTRODUCTION

As the old saying goes, Food is the God of the people. In the past, food has always been the main function of filling the stomach, but with the improvement of social economy and living standards, people are increasingly emphasizing the issues of food quality, nutritious and healthy quality of life, environmental friendliness and cultural diversity, food is no longer regarded as just a substance to satisfy the basic physiological needs, but an important medium to connect the individual, the society and the nature. [1]As a result, food has become more closely related to other fields. Design, as a discipline focused on problem solving and innovation, is profoundly influencing the way food is produced, consumed and experienced through its unique perspective and approach. The cross-fertilization of food and design studies is emerging as a high-profile research area. However, the cross-fertilization of food and design is not an overnight process; it involves a complex multidisciplinary body of knowledge including, but not limited to, the fields of nutrition, material science, psychology, anthropology, and art and design. Therefore, in order to comprehensively understand and grasp the development, research hotspots, and future trends of this field, this study adopts the method of visual analysis to systematically sort out and deeply analyze the relevant literature published in the past two decades, so as to provide references and assistance for the subsequent research on the cross-fertilization of food and design.

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2. DATA SOURCES AND RESEARCH METHODOLOGY

The data samples of this paper are taken from the database of China Knowledge Network (CNKI), and in order to ensure the typical representativeness and research value of the research results in the field of social sciences, the time limit is set to the period of 2004-2024, and the key words “food”, “diet” and “design” are selected as the data types. “food”, ‘diet’, ‘design’ as the keywords, and the type of data was selected as journal literature, and the literature was screened to eliminate irrelevant data, and finally 428 pieces of valid literature were obtained. Taking the valid literature data as the research sample, CiteSpace was used to visualize and analyze the above retrieval results. The specific search parameter settings are shown in Table 1. The research framework is shown in Fig. 1, firstly, the node type selection in the software is used to analyze the literature data to understand the publication rate, time distribution, issuing institutions and issuing authors; secondly, the keyword analysis is focused to summarize the literature for the distribution of outputs, the current status of research and hotspots, and to predict the future development trend.

Table 1. Parameterization of the search

Search Settings	Elements	Parameter Settings	Elements
Data source	SCI，CSSCI,Core Journals，EI	Time Slicing	2004.1-2024.7
Search Keywords	Design，Food、Diet	Year Per Slice	2
Type of Literature	Academic journals	Node Types	Author; Institution; Keyword
Number of documents	428	G-index	25
Time interval	2004-2024	TopN	50
Date of search	2024.7.14	TopN%	10

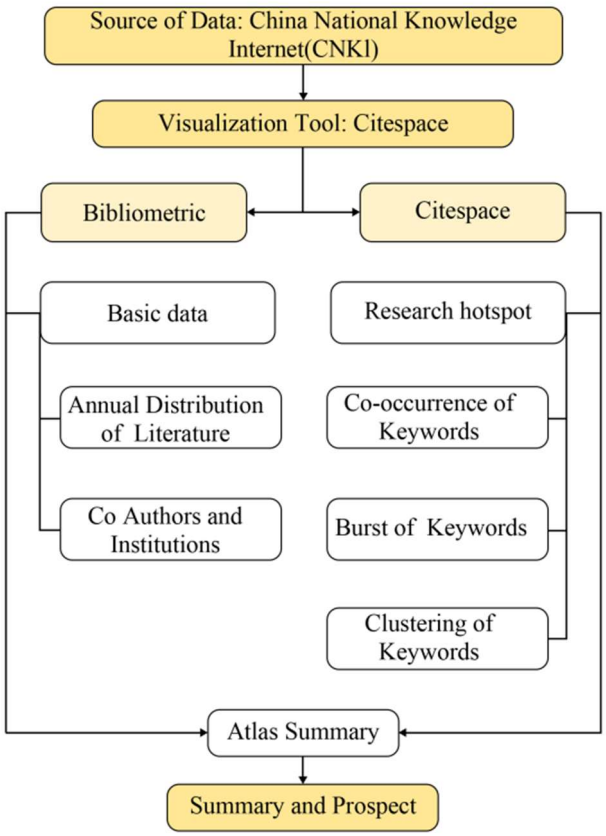


Figure 1. Research framework

3. BIBLIOMETRIC RESULTS AND ANALYSIS

3.1. Analysis of the Annual Number of Published Literature

The chronological graph of paper publication is an important indicator of the development of a research field. The data derived from the CNKI search were processed and extracted to obtain a statistical graph of the annual number of publications in its literature, see Fig. 2. As can be seen from the figure, there is an overall increasing trend in the number of publications about the research field of cross-fertilization of food and design in China. According to the overall trend, the research roughly shows three stages of development: (1) a slow upward trend from 2004 to 2010, when there were fewer studies in the subject area of food and design, and the annual number of publications was less than 10. (2) A rapid growth trend from 2011 to 2016, from 7 articles in 2011 to 42 articles in 2016. During this period, Chinese scholar Wang Yun [2] translated a paper published by design historian Prof. Victor Margolin [3] on the topic of food design and appeared in the CNKI database as the first core article in Chinese, which elaborated on the relationship between food and design from the perspective of design history, sorted out the development of the food design field The paper explains the relationship between food and design from the perspective of design history, summarizes the development of the food design field, and points out the future trend for the subsequent research. At the same time, a number of design project courses with food as the research object have emerged in Chinese universities, for example, Professor Zhang Linghao of Jiangnan University carried out a design project course to study the behavior of food culture [4]. In addition, in 2015, the United Nations also promulgated the 17 goals of sustainable development, which further promoted scholars to pay attention to food issues. (3) There is a fluctuating growth trend from 2017 to the present and peaks at 48 articles in 2023. At this stage, the interdisciplinary nature of the field of food and design is becoming more and more prominent.In 2018, the Central Committee of the Communist Party of China formally put forward the concept of “new liberal arts”. In the context of the Ministry of Education's promotion of the construction of new liberal arts, the research field of food and design cross-fertilization has high research value and development space as a cross-disciplinary theme. In the CNKI database, the disciplinary fields involved in the study of food and design are constantly enriched, and the cross-fertilization with the fields of medicine, computer science, sociology and so on is getting closer and closer. Universities have also opened food-themed design courses and laboratories, for example, the Tsinghua Academy of Fine Arts has opened a ‘Food Design Workshop’.

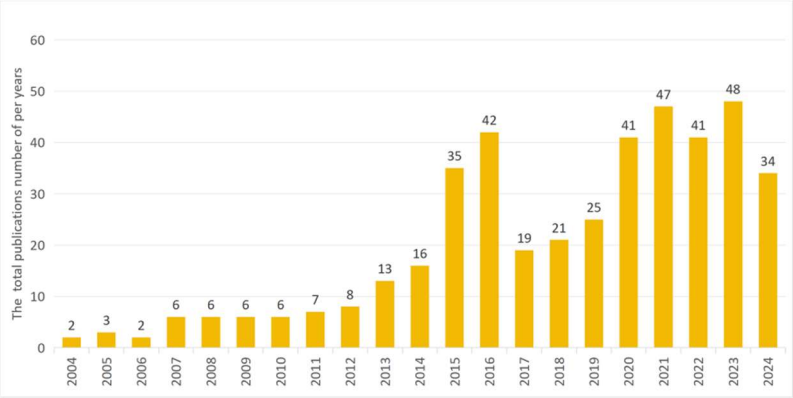


Figure 2. Statistical chart of the annual number of publications

3.2. Analysis of Research Institutions and Authors

Through CiteSpace to CNKI database of the amount of literature issued by the statistics of the amount of domestic issued by the top five units are colleges and universities, see Table 2. from Table 2 can be seen, China's current literature on the cross-fertilisation of food and design is concentrated in

institutions of higher learning, in which the amount of articles issued by Jiangnan University ranked the first, after reading the literature can be seen, the research of this issuing institution focuses on the research on the food culture in the service design, experience design. service design and experience design. Wuhan University of Light Industry (12 articles), Tsinghua University (9 articles), Wuhan University of Technology (9 articles), Beijing Institute of Fashion Technology (8 articles), and Nanjing Forestry University (8 articles) followed. In terms of the types of colleges and universities, mainly comprehensive, science and technology, art, agriculture and forestry colleges and universities are the main ones. From the perspective of discipline level, design is a strong discipline in Jiangnan University, Wuhan University of Technology and Beijing Institute of Fashion Technology, with more related research progress. In terms of geographical distribution, Jiangsu, Hubei and Beijing have six higher education institutions ranked in the top ten, which are the main body in the research field of cross-fertilisation of food and design.

Table 2. Ranking of institutions in terms of the number of publications (top 6)

Ranking	Institution	Count
1	Jiangnan University	22
2	Wuhan Polytechnic University	12
3	Tsinghua University	9
4	Wuhan University of Technology	9
5	Beijing Institute of Fashion Technology	8
6	Nanjing Forestry University	8

In terms of authors' publications, a statistical ranking of the authors shows that there are 227 scholars who have carried out relevant research. The top five authors are He Songfei (Beijing Institute of Fashion Technology, 6 articles), He Renke (Hunan University, 4 articles), Zhou Rui (Xihua University, 4 articles), Hu Fang (China Academy of Art, 3 articles), and Zhang Xian (Jiangnan University, 3 articles), which are shown in Table 3. As can be seen, the most prolific authors come from universities. He Songfei pays more attention to the research of sustainable field in food design; He Renke mainly studies the relationship between food culture and design; Zhou Rui mainly focuses on the application of food culture in packaging design; Hu Fang mainly studies the food experience and sustainable design of food; Zhang Xian mainly studies the application of food in service design. While focusing on relevant theoretical research, they are also committed to promoting the practice of university programmes.

Table 3. Ranking of authors in terms of publications (top 5)

Ranking	Author	Count	Institution
1	He SF	6	Beijing Institute of Fashion Technology
2	He RK	4	Hunan University
3	Zhou R	4	Xihua University
4	Hu F	3	China Academy of Art
5	Zhang X	3	Jiangnan University

3.3. Keyword Co-occurrence Analysis

Cluster analysis of the literature through CiteSpace software, the keywords with close relationship are integrated into one class, and multiple effective clusters are obtained, finally forming a keyword co-occurrence clustering network, which can effectively reflect the research hotspots of the cross-

fertilisation of food and design [5], see Fig. 3.As can be seen from Fig. 3, the research hotspots of the cross-fertilisation of food and design are mainly categorised into four major research directions, i.e., food and experience design, food and health design, food and sustainable design, and food and socio-cultural innovation design.

(1) Direction 1: Food and Experience Design Research

In CNKI database, '#1 food culture' and '#6 service design' form a cluster integrating the fields of psychology, architecture and sociology. The keywords that appear more frequently are 'food utensils', 'tableware design', 'experience design', 'service design'. 'In the '#1 food culture' cluster, scholars pay attention to the research of emotion and experience in eating utensils, such as Li Yajuan et al [6], from the perspective of emotional cognition of eating utensils for eating utensils experience design; Qiao Yu [7] from the perspective of user experience and emotional needs to summarise the future development trend and design principles of eating utensils design. development trend and design principles. In the '#6 Service Design' cluster, scholars focus on the service experience research in healthy eating, for example, Meng Kaining et al. [8] carried out the design research of healthy dietary app from the perspective of service design to help users form the concept of healthy eating.

(2) Direction 2: Food and Health Design Research

In CNKI database, '#4 Interface Design' and '#7 Chronic Disease' form a cluster integrating medical, management and sociological fields. The cluster includes the keywords "healthy diet", "chronic diseases" and "elderly people", which mainly includes two categories of research literature. The first category is mainly based on the dietary needs of special groups. Li Nawen et al. [9] propose a light-eating smart kitchenware design strategy for the slimming group, which broadns our thinking for the exploration of the product design and health design of light-eating kitchenware. The other category carries out research in the field of healthy diet and lifestyle with a systematic perspective, such as Chen Siyue et al [10], who adopt a gamified approach to build a healthy diet APP to provide a good user experience.

(3) Direction 3: Food and Sustainable Design Research

In the CNKI database, '#5 Food Design' forms a cluster that integrates the fields of dietary anthropology, environmental science and computer science. The cluster contains keywords such as 'low carbon design', 'food design', 'innovation' and 'food'. Scholars focus on the possibility of food design in the context of sustainability, such as Liu Junyan et al. [11], who researched the future development of food design in the context of the epidemic era.

(4) Direction 4: Food and Socio-Cultural Innovation Design Research

In the CNKI database, '#0 Design', '#2 Packaging Design' and '#3 Graphic Design' form a cluster integrating the fields of dietary anthropology, social sciences and communication. The group includes 'traditional culture', 'traditional culture' and 'traditional culture'. The keywords 'traditional culture', 'regional culture' and 'local culture' are included. Scholars in this cluster mainly analyse the cultural deconstruction and reconstruction of representative Chinese food cultures and regional food cultures, e.g., An Conggong et al. [12] explored the application of Pingyao regional culture in public facilities. For example, Deng Wenbang et al. [13] explored how regional cultural characteristics are integrated into the design of self-heating lunch boxes.



Figure 3. Keyword clustering

3.4. Analysis of Research Hotspot Changes and Frontier Trends

3.4.1. Changes in Research Hotspots

In order to further explore the development stages and cutting-edge trends of the research field of cross-fertilisation of food and design, and to have a clearer understanding of the influence change and evolution trajectory of its research hotspots, a keyword timeline map was drawn using Timeline View in CiteSpace, see Fig. 4. It can be seen in Fig. 4 that, from 2004-2010, the clusters #0 (design) and #1 (food culture) in Direction 1, Food and Experience Design Research, appeared the earliest, followed by the clusters #1 (food culture). Food and Experience Design Research', cluster #0 (design) and cluster #1 (food culture) appeared the earliest, followed by cluster #3 (graphic design) and cluster #2 (packaging design) in Direction 4, "Food and Cultural Innovation Design Research" and Direction 2, "Food and Health Design Research". Cluster #7 (Chronic Disease) in Direction 2 'Food and Health Design Research'. This phase of food and design intersection research mainly focuses on the direction of experience design, containing keywords such as diet, utensils, food culture, tableware design, etc. Between 2010 and 2020, the literature volume of #5 (food design) in direction three 'food and sustainable design research' increases and becomes an emerging research hotspot, from the keyword From the keywords 'innovation', 'low carbon design' and '3d printing', it can be seen that scholars are beginning to focus on design interventions in food sustainability. Meanwhile, the amount of literature in Direction 4 'Food and Culture Innovation Design Research' has increased since 2010, including 'packaging design', 'traditional culture', 'grains and cereals' and 'food and culture'. 'After 2020, the literature volume of Direction 2 'Food and Healthy Design' will increase. After 2020, the literature of #4 (interface design) in Direction 2 'Food and Health Design Research' began to increase, and the research hotspots expanded from focusing on the dietary needs of special groups to guiding the general public in healthy diet and health management. For example, the design of a game-based approach to cultivate people's concept of healthy eating, and the design of slimming diet apps. Cluster #0 (Design) and Cluster #1 (Food Culture) in Direction 1 'Food and Experience Design Research' still maintain a high degree of enthusiasm.



Figure 4. Timeline view of "co-citation analysis"

3.4.2. Analysis of Research Trends

The emergent words are the keywords that appear in the research field with explosive growth in a period of time. The development and change of emergent terms can reflect the dynamic development trend of the research field as a whole. [14] Conducted keyword emergence analysis of the literature through Burst Terms in CiteSpace, and drew a keyword emergence map of the research field of cross-fertilisation of food and design from 2004 to 2024, and detected 15 emergent words, see Fig. 5. firstly, in terms of the emergence time, the 'tableware design ' has the earliest emergence time, starting in 2007. During this period, scholars in China paid attention to tableware design under food culture and explored how tableware design conveyed food culture. Keywords that will continue to explode until 2024 include: 'food design' in Cluster #5 (Food Design) of Direction 3 'Food and Sustainable Design', which has attracted much attention in recent years, prompting scholars to explore more possibilities for sustainable food design in the future; 'food design' in Direction 3 'Food and Sustainable Design'; and 'food design' in Direction 4 'Food Design', which has attracted much attention in recent years. In recent years, environmental pollution and food waste issues have attracted much attention, prompting scholars to explore more possibilities for sustainable food design in the future; 'Food Packaging' in Cluster #3 (Graphic Design) of Direction 4 'Food and Socio-Cultural Innovation'. The research on how to design food packaging to make it more attractive to consumers, keep the food fresh, and protect the environment; 'Sustainable Development' in cluster #1 (Food Culture) and 'WeChat Apps' in cluster #0 (Design) of Direction 1 'Food and Experience Design'. This shows that today's consumers are increasingly looking for unique, personalised experiences rather than just basic physiological needs. Food is no longer just for filling the stomach, but has become a way of cultural, social and personal identity expression; Direction 2, 'Food Education' in Cluster #4 (Interface Design) of 'Food and Health Design', with the increased attention to healthy eating, how to design healthier and more nutritious food products, and how to make the food more nutritious. As people's concern for healthy eating increases, how to design healthier and more nutritious food is a direction worth studying.

Secondly, in terms of emergence intensity, the highest total emergence intensity is in direction 1 "food and experience design (21.39)", including the keywords "tableware design" and "design", "food", 'tableware', 'service design', 'eating utensils', "WeChat", 'Sustainability'. People are iron and food is steel, food is an important source of nutrition for human beings, and food experience design is dedicated to enhancing people's sensory experience during the dining process. The keywords with higher outbreaks include "design (4.18)" in Direction 1 "Food and Experience Design", "food design (4.18)" in Direction 3 "Food and Sustainable Design", "food design (4.18)" in Direction 4 "Food and

Sustainable Design", and "food design (4.18)" in Direction 5 "Food and Sustainable Design". Food Design (4.1)" in Direction 3 'Food and Sustainable Design' and 'Food Packaging (3.34)' in Direction 4 'Food and Socio-Cultural Innovation'.

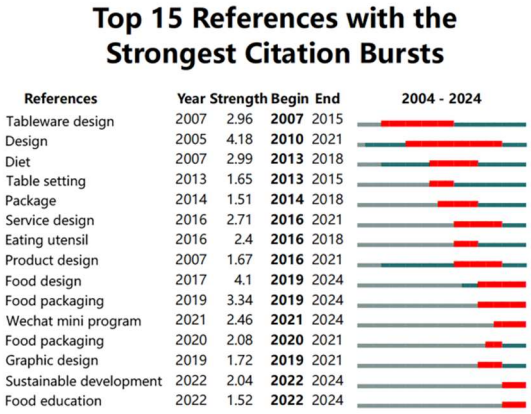


Figure 5. Keyword emergence map

4. CONCLUSION AND PROSPECT

From the conclusion of the above analysis, the research on the cross-fertilization of food and design can be summarized into four main research directions: food and experience design, food and health design, food and sustainable design, and food and socio-cultural innovation design. In terms of research hotspots, there is a shift from single to multiple development, from "food culture research and packaging design research" to "design intervention in food sustainability research", and then to "food health system design research", The field of "Social Innovation and Cultural Research" has shown an overall increase in the number of articles published in this field. The overall trend of the articles published in this field shows an increasing trend, which also fully demonstrates the potential of exploring the integration of food and design. In conclusion, the following outlook for the future development of the field of food and design integration is made.

(1) Designing interdisciplinary cross-fertilization

Nowadays, the booming development of science and technology greatly affects our lives and promotes the cross-fertilization of various disciplinary fields. At present, the cross-fertilization research of food and design studies is relatively lacking in the combination of technological disciplines, although there are scholars who have used 3D printing technology to create future food, and virtual reality technology and augmented reality technology to realize different practical activities of food experience, but scholars focus more on the research of technology itself, and the integration between disciplines is not deep enough. Therefore, the exploration of new technologies and their use in food and design studies is one of the important directions for future development.

(2) Integration of sustainable concepts into design

In the context of global sustainable development, the concept of sustainability is continuously penetrating into food and design research. In recent years, research perspectives have broken through the traditional dimensions and formed a multi-directional evolutionary path: scholars have gradually shifted from the early focus on global dietary standardization, food waste management, and raw material recycling, to the composite research fields of local food culture innovation and design research, future food design, and food experience design. It is worth noting that the research on the ecological carrying capacity of human dietary structure and the sustainable development of food culture genealogy are particularly crucial, and they have constituted the axis of current academic

discussions. This shift in research not only reflects the localized response to the global food crisis, but also highlights the contemporary demand for the transformation of food culture capital into industrial innovation momentum.

(3) Diversification of design content

From the perspective of keyword clustering, the literature reflects the cross-fertilization of academia, but with a single field of application. Our research on the cross-fertilization of food and design studies is still in the primary stage, and most of the research on the design application of food lacks the in-depth development of the core connotation of food, so that it lacks aesthetics and innovativeness, and at the same time lacks in-depth theoretical elaboration, and does not form a mature theoretical system and in-depth integration between disciplines. Therefore, the cultivation and introduction of more comprehensive talents across fields and disciplines, and the strengthening of cooperation between institutions and universities will have a certain role in promoting the cross-fertilization of food and design studies in the future. In addition, in the context of globalization, researchers and practitioners should intervene from different disciplinary perspectives to explore how to better respond to the global issues of dietary equity, food safety, and food sustainability.

CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

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