

Research Trends of Microplastic in Food in China based on Social Network Analysis

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Abstract: To understand the research trends on microplastics in food in China, study conducted a Social Network Analysis (SNA) based on academic literature published in the past 10 years. The research focused on papers related to microplastics in food published between June 2013 and June 2023, using the search terms “microplastics” and “food”. Keyword frequency analysis, node degree analysis, and SNA were used. The results showed that degree centrality of “microplastics”, “pollution”, “toxicity”, “source and distribution” and “ecological effect” were above 0.700, indicating that over 70% of the existing Chinese papers on microplastics are focused on the pollution and toxic effects of microplastics on the ecosystem, which is currently the main research direction, providing reference value for improving China's food safety status and decision-making.

Key words: Food; Microplastic; Node Degree Analysis; SNA; Research Trend

According to data provided by the European Plastic Manufacturers Association, global plastic production from 2018 to 2021 was 366 million tons, 375 million tons, 376 million tons, and 391 million tons, respectively^[1]. A survey has shown that plastic accounts for as much as 60% to 80% of the garbage thrown into the ocean^[2]. Approximately 9.5 million tons of plastic garbage flow into the ocean every year, which is referred to as a serious source of pollution^[3]. Especially, microplastics in plastic garbage account for about 15% to 31% of marine plastic garbage^[4]. In recent years, the outbreak of COVID-19 has led to a sharp increase in the production of disposable medical and protective equipment, and has also brought new plastic pollution challenges^[5].

Microplastics are defined as micro synthetic polymer compounds with a diameter less than 5 mm^[6]. Hydrobiont often mistake plastic in water bodies for food capture and ingestion, leading to the accumulation of microplastics in their body. Researchers have found over 18% of plastic fragments in fish collected in the Mediterranean region^[7]. The emergence of microplastics not only brings chaos to ecosystems, but also enters human bodies in the food chain through bioaccumulation, causing various hazards and harming human health^[8].

Previous studies have mostly focused on using traditional paradigms to organize the research and progress related to microplastics in food^[9], lacking a systematic analysis and revelation of the relationship and degree of correlation between research topics about microplastics in food from a statistical perspective. Social Network Analysis (SNA) has become a popular social science research method, which combines graph theory and mathematical models to study the relationships between social actors^[10]. Therefore, this study uses degree centrality analysis and SNA to sort out the current research progress on food microplastics in China, aiming to understand the research trends of food microplastics and predict future research directions, providing ideas for food safety research.

1. Data Source and Methods

1.1 Text Mining

Literatures were mainly obtained from the academic literature database “China National Knowledge Infrastructure

(CNKI)” and a search was conducted for topics as “microplastics” and “food”. Academic papers published in the past 10 years were used as the search objects.

1.2 Data Processing

All keywords from extracted academic papers related to “microplastics” and “food” were obtained, Excel was used to extract keyword fragments from all literature. Count the frequency of keywords and import the results into BibExcel software to generate a keyword co-occurrence matrix^[11]. Use the “NetDraw” function provided by Ucinet software to generate a social network diagram of food microplastics related research^[12], and obtain the degree centrality of the connectivity between the obtained keywords^[13].

2. Results and Discussion

2.1 Publication Status of Papers

According to the search results, research on food microplastics in China started relatively late the first article about microplastic was published in 2015, and the proportion of review literature such as research progress is high (43.6%), which implies that basic research has not yet been in-depth, and there is room for further development.

It was found that most of the research in China focuses on the impact of marine pollution and ecosystems. Research on microplastic pollution in terrestrial environments has gradually emerged^[14]. In addition to hydrobiont, research on microplastics in processed foods or agricultural products such as dairy products are also emerging in recent years^[15]. The above analysis results are consistent with the research trend analysis of microplastics in food by Cho et al.^[16], indicating that research in China has to some extent been in line with international research.

2.2 Keyword Frequency Analysis

584 keywords were finally obtained and Table 1 shows the top 20 keywords after synonymous merging, the frequency of “microplastics”, “toxicity”, “hydrobiont” is more than 30 times, indicating that the overall direction of Chinese research focus. The keywords “health” and “food safety” rank ninth, indicating that the research on the relationship among microplastics in food, health hazards and food safety problems has attracted the attention of Chinese scholars. It is worth mentioning that the keyword “food contact materials” is also in Top 20, indicating that researches on the safety of plastic food packaging has also given attention.

Table 1 Top 20 keyword frequency rank from 2013 to 2023 after synonymous merger

Rank	Keyword	Frequency	Rank	Keyword	Frequency
1	microplastics	125	12	mechanism	12
2	toxicity	35	13	plastic pollution	10
3	contaminated	32	14	microorganism	10
4	hydrobiont	31	15	prevention countermeasures	8
5	water environment	27	16	degradation	8
6	source and distribution	26	17	feeding	8
7	detection and analysis	25	18	bioaccumulation	8
8	eco-environmental effects	22	19	heavy metal	8
9	health	16	20	food contact materials	6
10	food safety	16	21	new pollutants	6
11	soil environment	15	22	plastic	6

Figure 1 summarizes the annual frequency changes of keywords with word frequency ≥ 15 . It can be seen that starting from 2019 the research on microplastics and “health” and “food safety” has gradually appeared.

2.3 Degree Centrality Analysis

In this study, 32 keywords with high degree of centrality (connection degree ≥ 3) appeared. Table 2 shows the top 20

keywords with the highest degree of centrality. The results show that the degree center of “microplastics” is the highest (Cd=1), that is, the keyword is related to all nodes. On the other hand, “health” and “food safety” related to food and human health in this analysis have also been extracted, and the degree centrality is 0.516 and 0.484 respectively, which means that the research on food safety and health issues is not deep enough compared with other fields.

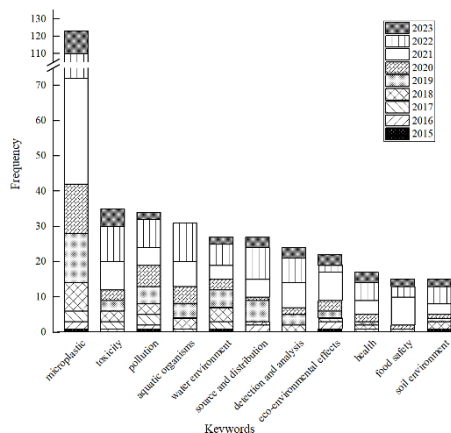


Figure 1 Keyword frequency trend in recent years

Table 2 Top 20 Degree Centrality Result from 2013 to 2023

Rank	Keyword	Degree centrality	Rank	Key word	Degree centrality
1	microplastics	1.000	11	health	0.516
2	pollution	0.774	12	food safety	0.484
3	toxicity	0.742	13	heavy metal	0.484
4	source and distribution	0.710	14	plastic pollution	0.419
5	ecological effect	0.710	15	new pollutants	0.419
6	detection and analysis	0.677	16	prevention countermeasures	0.387
7	hydrobiont	0.613	17	soil fauna	0.387
8	water environment	0.613	18	microorganism	0.387
9	soil environment	0.548	19	degradation	0.355
10	mechanism	0.548	20	bioconcentration	0.355

2.4 Social Network Analysis

Figure 2 shows the visualization and structural schematic diagram of keywords. The center of the network is “microplastic”, and its node legend is the largest, which means strongest connection degree and high media centrality. Keywords directly related to food such as “feeding”, “food safety” and “health” also show strong connectivity, implying that future research may primarily focus on the harmful effects of microplastics intake by food on human body.

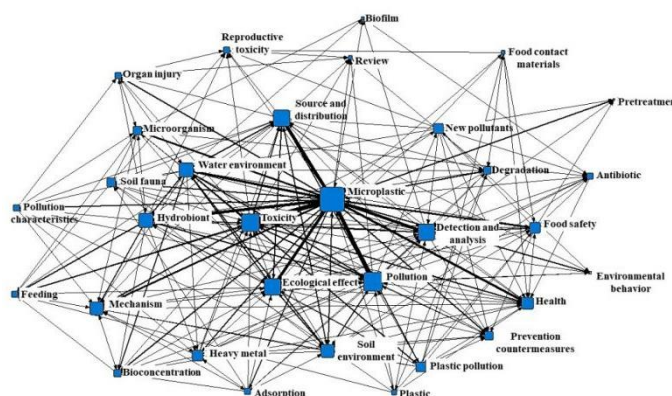


Figure 2 Network diagram for major central keywords

3. Conclusions

In this study, the research trends of microplastics in food in recent 10 years were explored by SNA, the existing research status and hot spots in this field were summarized, and the fields needing further research in the future were predicted, which provided ideas and theoretical basis for food safety research.

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