

# Visualization Analysis of International TCM Informatization Research Field

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**Abstract**—This paper analyzed 1,150 papers in the field of international TCM informatization research in the SCI and SSCI databases of WOS based on the knowledge mapping method, and revealed the development status of this research field. The results showed that China occupies an important position in the field of TCM informatization research from the perspective of research force and knowledge base, the results also showed that we had got some important research methods, main research objects and some fields related to the field of TCM informatization research, and 7 important research branch fields had been formed in the development process.

**Keywords**—TCM informatization, visualization analysis, knowledge mapping, knowledge base, development evolution

## I. INTRODUCTION

Traditional Chinese medicine refers to a medical knowledge system that has been developed independently before modern medicine. Mainstream medical institutions and scholars in the world are increasingly approving traditional Chinese medicine with the continuous integration of scientific exchanges in the world today. Traditional Chinese medicine has entered a new stage of rapid development in the world. In the past 5 years, the number of papers related to traditional Chinese medicine in SCI and SSCI has exceeded 200. This also proves that traditional Chinese medicine is becoming more and more important. This paper takes the knowledge mapping as the research method and traditional Chinese medicine informatization as the research object to reveal the development status of the research field in the world and provide relevant research references for relevant scholars.

## II. THE DATA SOURCE

The data used in this paper is from the data related to the informatization of traditional Chinese medicine in the Web of Science. Retrieval formula is  $TS=(('Traditional\ Chinese\ Medicine'$  and  $'information')$  or  $('Traditional\ Chinese\ Medicine'$  and  $'big\ data')$ ). Database includes SCI and SSCI, and literature type is article. 1,150 papers were finally retrieved.

## III. ANALYSIS OF RESEARCH FORCE

1,150 papers were imported into CiteSpace for analysis of the number of published papers of country or regional. Fig.1 shows the main issuing countries or regions in the research field of international TCM informatization. The number of published papers of China is far more than that of other countries or regions.

## IV. ANALYSIS OF KNOWLEDGE BASE

The knowledge base analysis of international TCM informatization research field can be obtained by importing 1,150 pieces of raw data into CiteSpace. The analysis results are as follows.

### A. Analysis of Knowledge Base of Cited Journals

TABLE I and Fig.2 show the main knowledge base of cited journals, respectively. It can be seen that the knowledge base of this field mainly comes from the journals in the fields of Medicine and Chemistry. In addition, some knowledge bases of cited journals also belong to Plant Sciences, Nutrition & Dietetics, Spectroscopy, etc.

### B. Analysis of Knowledge Base of Cited Authors

Fig.3 shows the main knowledge base of cited authors. The highest cited author in the knowledge base is Yi Wang of Zhejiang University from the perspective of knowledge base of cited authors, with a citation frequency of 89. Followed by Shao Li of Tsinghua University (cited 50 times), Xijun Wang of Heilongjiang University of Chinese Medicine (cited 43 times). It can be seen that the literatures published by these researchers have become a very important knowledge base in this field, so they become very important scholars in this field.

### C. Analysis of Knowledge Base of Cited Literatures

Fig.4 shows the main knowledge base of cited literatures. The most cited paper is Normile D's "Asian medicine: The new face of traditional Chinese medicine" published on SCIENCE in 2003, and with a citation frequency of 33[1].

## V. ANALYSIS OF KEYWORDS

We can get the keyword hotspot analysis results in the field of international TCM informatization research by importing 1,150 papers into CiteSpace for the analysis of keywords. The analysis results are as follows.

The main keywords are shown as Fig.5. The most frequent keyword is traditional Chinese medicine and the frequency is 341. The keyword also represents the research topic in this field.

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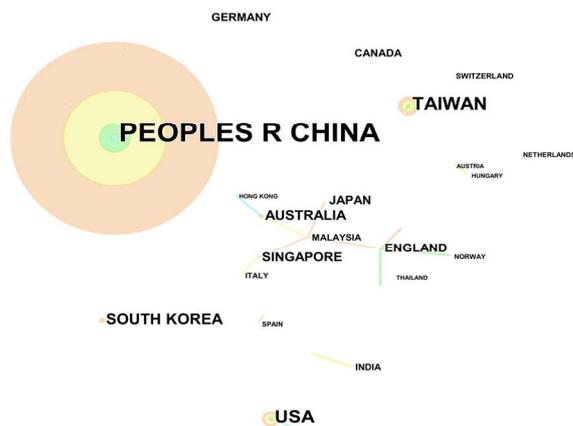


Fig. 1. Knowledge mapping of the number of published papers of countries or regions

TABLE I. PART OF THE LIST OF KNOWLEDGE BASE OF CITED JOURNALS

Cited times	Journal	the Fields of WOS
381	Journal of Ethnopharmacology	Chemistry, Medicinal; Integrative & Complementary Medicine; Pharmacology & Pharmacy; Plant Sciences
309	Journal of Pharmaceutical and Biomedical Analysis	Chemistry, Analytical; Pharmacology & Pharmacy
259	Plos One	Multidisciplinary Sciences
234	Evidence-based Complementary and Alternative Medicine	Integrative & Complementary Medicine
160	Nature	Multidisciplinary Sciences
158	Journal of Separation Science	Chemistry, Analytical
149	American Journal of Chinese Medicine	Integrative & Complementary Medicine; Medicine, General & Internal
135	Lancet	Medicine, General & Internal
129	Analytica Chimica Acta	Chemistry, Analytical
125	Biological & Pharmaceutical Bulletin	Pharmacology & Pharmacy
114	Analytical Chemistry	Chemistry, Analytical
102	European Journal of Pharmacology	Pharmacology & Pharmacy

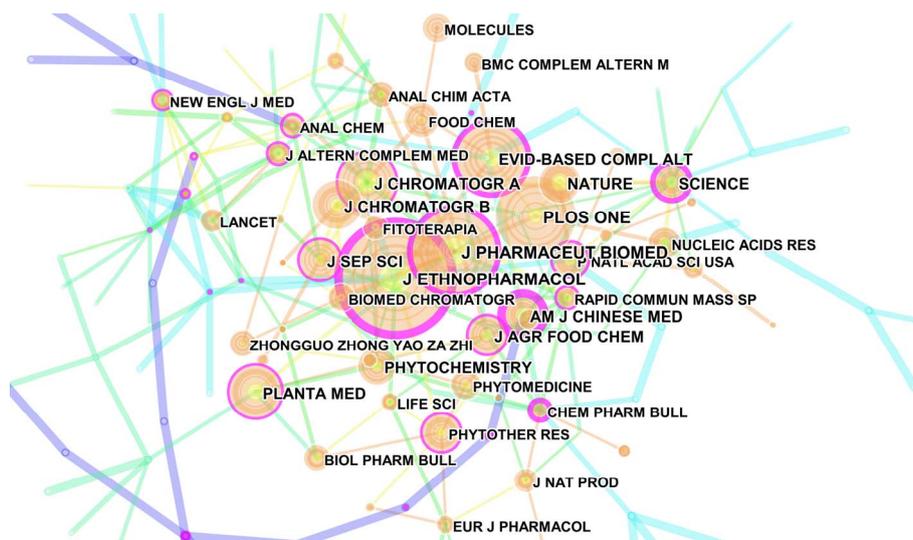


Fig. 2. Knowledge mapping of knowledge base of cited journals



Chinese medicine based on data mining[2-3], (2) Fingerprinting analysis based on high performance liquid chromatography[4-10], (3) Study on plasma components of mice based on liquid chromatography[11-12], (4) Research on development and application of traditional Chinese medicine database[13-19], (5) Metabonomics study based on high performance liquid chromatography and electrospray

ionization mass spectrometry[20-21], (6) Research on structural identification of compounds based on rapid liquid chromatography and electrospray ionization tandem mass spectrometry[22-23], (7) Image study of tongue diagnosis[24-25]. The core literatures contained in each of the 7 branch fields are shown in TABLE III- TABLE IX, respectively.

TABLE II. THE LIST OF BRANCH FIELDS

Branch field	Number of core literatures	Average publication year
Research on component of traditional Chinese medicine based on data mining	4	2007.3
Fingerprinting analysis based on high performance liquid chromatography	13	2006.8
Study on plasma components of mice based on liquid chromatography	5	2009.8
Research on development and application of traditional Chinese medicine database	9	2005.8
Metabonomics study based on high performance liquid chromatography and electrospray ionization mass spectrometry	3	2011.7
Research on structural identification of compounds based on rapid liquid chromatography and electrospray ionization tandem mass spectrometry	2	2006.5
Image study of tongue diagnosis	2	2005.5

TABLE III. PART OF THE CORE LITERATURES OF (1)

No.	Title of literature
1	Multi-component HPLC fingerprinting of radix salviae miltiorrhizae and its LC-MS-MS identification
2	New Drug R&d Of Traditional Chinese Medicine: Role Of Data Mining Approaches

TABLE IV. PART OF THE CORE LITERATURES OF (2)

No.	Title of literature
1	Multiple chromatographic fingerprinting and its application to the quality control of herbal medicines
2	Chemical information of Chinese medicines: A challenge to chemist

TABLE V. PART OF THE CORE LITERATURES OF (3)

No.	Title of literature
1	Analysis of the constituents in the rat plasma after oral administration of Yin Chen Hao Tang by UPLC/Q-TOF-MS/MS
2	Rapid and global detection and characterization of the constituents in ShengMai San by ultra-performance liquid chromatography-high-definition mass spectrometry

TABLE VI. PART OF THE CORE LITERATURES OF (4)

No.	Title of literature
1	Research and development of 3D molecular structure database of traditional Chinese drugs
2	Traditional Chinese medicine database and application on the Web
3	Ontology development for unified traditional Chinese medical language system
4	Computational methods for Traditional Chinese Medicine: A survey

TABLE VII. PART OF THE CORE LITERATURES OF (5)

No.	Title of literature
1	Identification of metabolites of crude and processed Fructus Corni in rats by microdialysis sampling coupled with electrospray ionization linear quadrupole ion trap mass spectrometry
2	Metabolomics study on Fuzi and its processed products using ultra-performance liquid-chromatography/ electrospray-ionization synapt high-definition mass spectrometry coupled with pattern recognition analysis

TABLE VIII. THE CORE LITERATURES OF (6)

No.	Title of literature
1	Structural elucidation and identification of alkaloids in Rhizoma Coptidis by electrospray ionization tandem mass spectrometry
2	Structural characterization and identification of iridoid glycosides, saponins, phenolic acids and flavonoids in Flos Lonicerae Japonicae by a fast liquid chromatography method with diode-array detection and time-of-flight mass spectrometry

TABLE IX. THE CORE LITERATURES OF (7)

No.	Title of literature
1	An image analysis system for tongue diagnosis in traditional Chinese medicine
2	Region partition and feature matching based color recognition of tongue image

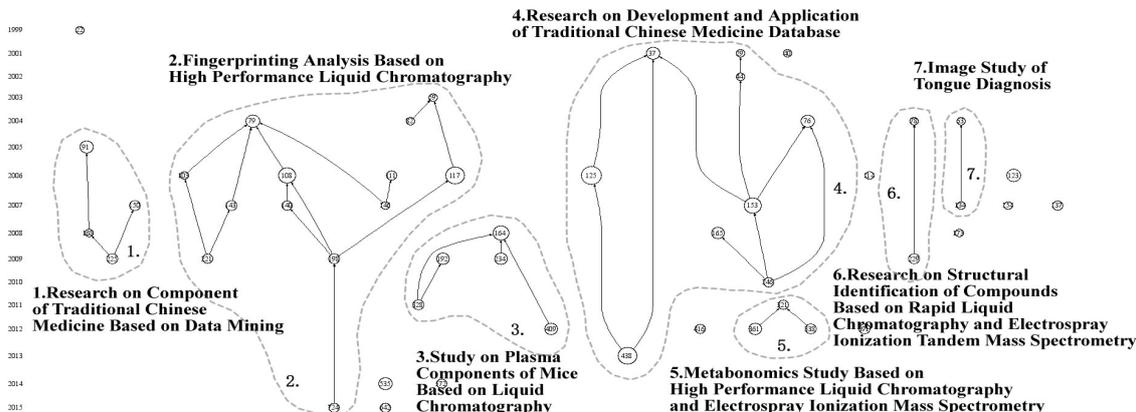


Fig. 6. Knowledge mapping of branch fields

### VII. CONCLUSION

From the perspective of the research force in the field of international TCM informatization research, the number of published papers of China is far more than that of other countries or regions.

From the perspective of the knowledge base in the field of international TCM informatization research, the most important knowledge base of cited journals comes from the journals in the fields of Medicine and Chemistry. Five of the top eight scholars cited in the knowledge base are Chinese scholars, which also shows that China is the core of the field of international TCM informatization research.

From the perspective of the keywords in the field of international TCM informatization research, important research methods mainly include performance liquid-chromatography, in-vitro, mass-spectrometry, acupuncture, tandem mass-spectrometry, and liquid-chromatography, and the main objects include herbal medicine, cells, extract, alkaloids, flavonoids, cancer, plants, and rat plasma, and these fields such as alternative medicine, pharmacokinetics, metabolomics, etc. become closely related to the field of international TCM informatization research.

From the perspective of the branch fields of international TCM informatization research, there are 7 important research branch fields formed in the development process which are as follows: (1) Research on component of traditional Chinese medicine based on data mining, (2) Fingerprinting analysis based on high performance liquid chromatography, (3) Study on plasma components of mice based on liquid chromatography, (4) Research on development and application of traditional Chinese medicine database, (5) Metabonomics study based on high performance liquid chromatography and electrospray ionization mass spectrometry, (6) Research on structural identification of compounds based on rapid liquid chromatography and electrospray ionization tandem mass spectrometry, (7) Image study of tongue diagnosis.

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