Bibliometric analysis of research relating to the use of herbal medicine for rheumatoid arthritis between 1991 to 2021

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Abstract

Background: Rheumatoid arthritis (RA) is an inflammatory autoimmune disease, which is well known for its poor symptoms, and the incidence is increasing worldwide. Although conventional medicines are practiced initially, patients often move or accompany to complementary and alternative medicines for better outcomes. Herbal medications, one of traditional medicinal approach, are widely used in clinical conditions. However, no research has broadly reviewed the current research trends regarding the scope of herbal medicines in RA. The aim of this study was to conduct a bibliometric analysis of applications of herbal medicine for RA from 1991 to the present

Methods: We retrieved literature on herbal medicine for RA from the Web of Science database from 1991 to 2021. The VOSviewer program was used to analyze keywords, authors, countries, and organizations through visual knowledge mapping to assess the research hotspots and trends.

Results: A total of 516 articles were included in the analysis, which showed an increasing trend in the number of publications over time. Four clusters were identified from the keyword analysis: complementary and alternative medicine cluster, mechanism of the pain cluster, control for the pain cluster, and recent research trend cluster. People's Republic of China published 250 articles, which was the greatest number of publications, followed by the United States of America (82 articles) and South Korea (52 articles). Furthermore, Moudgil, KD of the University of Maryland published 15 articles about the mechanism of herbal medicine on autoimmune arthritis and their interaction with various drugs. Lu, AP of the Hong Kong Baptist University published 14 articles about herbal medicine interactions. On an institutional level, the China Academy of Chinese Medical Science published 33 articles, followed by the Hong Kong Baptist University and the University of Maryland with 27 and 20 articles, respectively. Clusters of organizations from the People's Republic of China and the United States of America revealed higher average citations for earlier average publication years.

Conclusions: This bibliometric study identified trends in herbal medicine for RA from 1991 to 2021, which may guide the hot topics and future directions in this research field.

Abbreviation: RA = rheumatoid arthritis.

Keywords: bibliometric analysis, herbal medicine, review, rheumatoid arthritis

1. Introduction

Rheumatoid arthritis (RA) is an inflammatory autoimmune disorder with an incidence of 1% worldwide.[1] It is caused by inflammation of the synovial membrane, additionally weakening the bone and cartilage around knee joint.[2] Both genetic and environmental factors play a key role in its development.[3,4] The susceptibility toward RA is determined by the pattern of specific genes, especially human leukocyte antigen and major histocompatibility complex.[5] Smoking is the main environmental factor that is associated with the progress of RA, and it also interacts with certain genes and increases susceptibility,[6] as well as negatively affects drug response in RA treatment.[7] The main conventional treatment for RA patients is the administration of disease-modifying antirheumatic drugs, which targets the immune system to slow down

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the progression of the disease.[8] However, due to the limited response and side effects of these drugs, majority of the patients adopt alternative treatment strategies in additional to conventional approach.[9]

Herbal medicine is a traditional Chinese medicinal approach that is frequently practiced in East Asian countries[10] and has been proven to be effective against various medical conditions such as dyspepsia,[11] osteoporosis,[12] and atopic dermatitis.[13] Herbal medications are usually on high demand among patients because of its advantage that conventional medicine rarely provides and its safety.[14] Herbal medicine is also used by RA patients as a complementary and alternative approach. Drug discovery research for identification and synthesis of an effective drug is one of the main stream in drug development market due to its long-term application and safety standards.[15] However, there are no studies that broadly review the current research trends regarding herbal medicines for RA.

Bibliometrics is a method of quantitatively analyzing a large amount of literature published in a specific field using mathematics and statistical tools. Specifically, it shows the relationship of studies regarding publication year, citation count, author, institution, and country.[16] Recently, graphical tools have been updated to visualize the results of large data. Bibliometric analysis is applied in various fields of medicine regarding autoimmune diseases such as psoriatic arthritis in complementary medicine field.[17] However, it has not been implemented in the field of herbal medicine concerning RA. This study aims to conduct a bibliometric analysis of herbal medicine for RA from 1991 to the present, based on all the published research in the main database regarding this subject to analyze the research trend.

2. Materials and methods

2.1. Data extraction and preprocessing

Data were extracted through the Web of Science (https://www.webofknowledge.com), published between 1991 and August 30, 2021. The search method was as follows.

(Rheumatoid arthritis) AND (herbal medicine OR herbal therapy OR herb therapy OR phytotherapy OR drugs, Chinese herbal OR ethnobotany)

Original articles and review articles were selected, and only English literature were included.

2.2. Data analysis

Selected studies were analyzed based on publication year, category, and journal. VOSviewer version 1.6.11 (Centre for Science and Technology Studies, Leiden University, Leiden, The Netherlands) was used to analyze and visualize the connections between keywords, authors, countries, and institutions. The similarity mapping method enables visualization of data by identifying similar facts and keywords based on the association strength measure. Ethical approval was not necessary because this study did not include any patients' information.

3. Results

From the search results, 779 articles were retrieved for the study. Further screening was done based on the category and language (original review article and English language, respectively), and a final of 516 articles were included in the study (Fig. 1).

3.1. Distribution in terms of publication years, research categories, and journals

The year of maximum publication was 2020 (64 articles), and minimum publication was 1995 (1 article). Overall, there was an increasing trend in the number of publications per year (Fig. 2).

The most frequently published field was Pharmacology Pharmacy with 256 articles, accounting for 49.6 % of all included articles (Table 1).

The journal that published the greatest number of articles was *Phytotherapy Research,* with 55 articles, followed by *Journal of Ethnopharmacology* and *Evidence-based Complementary and Alternative Medicine,* accounting for 48 and 25 articles, respectively (Table 2).

3.2. Analysis of keywords

Keywords from the entire 516 articles were analyzed, generating 4 clusters (Fig. 3A). Seventy-five keywords that appeared 10 times or more were analyzed (Table 3). The publication year was also visualized using VOSviewer (Fig. 3B). The intensity of the color is proportional to the year of publication; blue indicates the earliest and yellow indicates the most recent publications. Frequency of citation was also represented in intensity of color; blue corresponds to less cited articles and yellow for more cited articles (Fig. 3C).
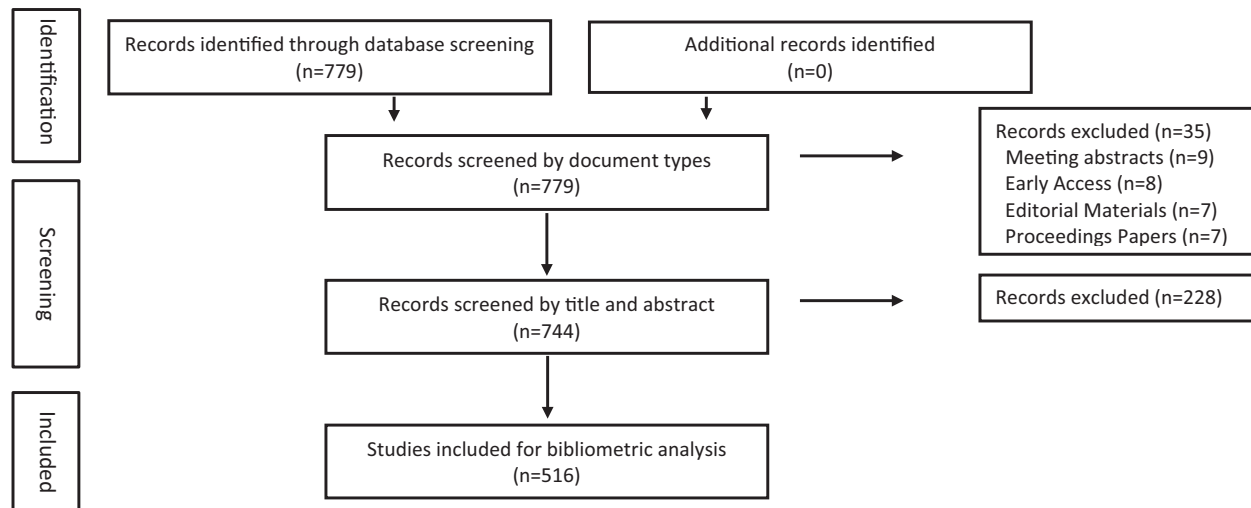
Figure 1. Flow diagram of the selection process.
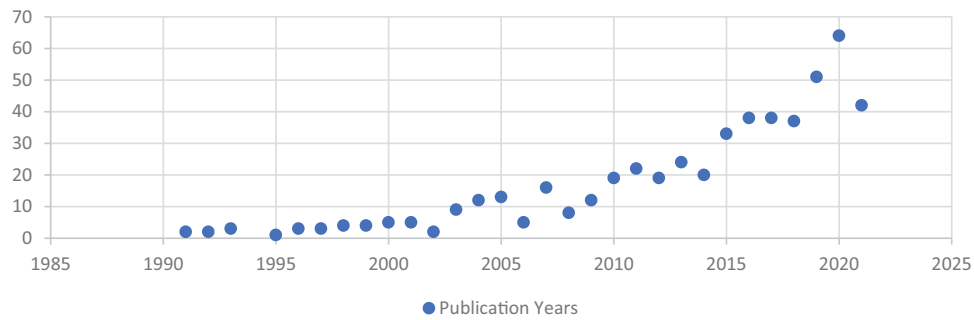
Figure 2. Annual number of publications on rheumatoid arthritis-related herbal medicine between 1991 and 2021.

Table 1

Distribution of publications by categories.

Rank	Frequency (n)	Categories
1	256	Pharmacology Pharmacy
2	147	Integrative Complementary Medicine
3	78	Plant Sciences
4	35	Biochemistry Molecular Biology
5	34	Rheumatology
6	34	Chemistry
7	32	Research Experimental Medicine
8	30	Immunology
9	26	General Internal Medicine
10	17	Cell Biology

Table 2

Distribution of publications by journals.

Rank	Publications	Journal title	Impact factor (2020)
1	55	*Phytotherapy Research*	5.678
2	48	*Journal of Ethnopharmacology*	4.36
3	25	*Evidence-based Complementary and Alternative Medicine*	2.629
4	14	*Phytomedicine*	5.34
5	12	*Frontiers in Pharmacology*	5.81
6	11	*International Immunopharmacology*	4.932
7	8	*American Journal of Chinese Medicine*	4.667
8	7	*BMC Complementary and Alternative Medicine*	3.659
9	6	*Chinese Journal of Integrative Medicine*	1.978
10	6	*Journal of Rheumatology*	4.666

3.3. Analysis of authors of articles published between 1991 and 2021

Among the 516 publications, the author who published the highest number of articles was Moudgil KD (15 articles), followed by Lu AP (14 articles), Liu J (12 articles), Li Y (11 articles), Li J (10 articles), and Wang Y (10 articles) (Table 4). The VOSviewer software grouped authors who published 5 or more articles into 8 clusters (Fig. 4A). The first cluster included Lu, Aiping (383 cited), Jiang, Miao (250 cited), He, Xiaojuan (163 cited), Huang, Chao (156 cited), and Zhang and Chi (139 cited). The second cluster includes Moudgil, Kamal d. (448 cited), Venkatesha, Shivaprasad H. (301 cited), and Yu, Hua (164 cited). The third cluster included Li, Ping (169 cited), Wang, Chong-Zhi (128 cited), Yuan, Chun-Su (128 cited), and Zhang, Chung-Feng (128 cited). The fourth cluster included Lin, Na (187 cited), and Zhang, Yangqiong (127 cited). The fifth cluster was Ernst E (258, cited). The sixth cluster was Li, Yan (66 cited), the seventh cluster was Liu, Liang (175 cited), and the eighth cluster was Terasawa, K (61 cited).

Publication year was also analyzed and represented as clusters (Fig. 4B). A blue color indicates the author with an earlier publication year, and a yellow color indicates the author with a later publication year.

The average number of citations of authors was visualized as clusters; blue color represents lower number of citations and yellow represents higher number of citations (Fig. 4C). Inter cluster analysis was performed, and cluster 5 (Ernst, E) was identified to be more frequently cited than other

Figure 3. Analysis of keywords. (A) Keywords of studies on rheumatoid arthritis-related herbal medicine were categorized into 4 groups. (B) Analysis of keywords by the average publication year (blue: earlier, yellow: later). (C) Analysis of keywords by the average citations (blue: fewer, yellow: more).

authors within the clusters and had an earlier publication year (Table 5).

3.4. Analysis of country

Of the 516 articles, the country with the greatest number of publication was People's Republic of China, with a total of 250 articles, followed by the United States of America (USA) and South Korea with 82 and 52 articles, respectively (Table 6).

Countries that published 5 or more articles were analyzed and categorized into 5 clusters (Fig. 5A). The first cluster comprised India, Malaysia, Pakistan, and Saudi Arabia; the second cluster included Australia, Canada, and Germany; the third cluster included Japan, People's Republic of China, and South Korea; the fourth cluster included England and Iran; and the fifth cluster included Taiwan and the USA.

The average of publication year was analyzed and represented for each country in color bars; blue color indicates earlier years and yellow indicates recent years (Fig. 5B). The average number

of citations for different countries was analyzed (Fig. 5C). As the color bar turns blue, it indicates fewer citations and yellow color indicates a greater number of citations. The second cluster (Australia, Canada, and Germany) largely comprised earlier publications and was comparatively more cited than other clusters (Table 7).

3.5. Analysis of organization

The institution that published the greatest number of articles was the China Academy of Chinese Medical Science with 33 publications, followed by Hong Kong Baptist University and University of Maryland with 27 and 20 publications, respectively (Table 8).

Forty-six organizations with 5 or more related publications were analyzed. As a result, 12 clusters were identified (Fig. 6A; Table 9). The first cluster included China Japan Friendship Hospital, Chinese Academy of Science, Chinese University of Hong Kong, Guangzhou University of Chinese Medicine, Hong Kong Baptist University, etc. The second cluster included Harvard University, McGill University, University of Exeter, and University of Freiburg. The third cluster included Chonnam National University, Dongguk University, Korea Institute of Oriental Medicine, Kyung Hee University, etc. The fourth cluster was Anhui University of Chinese Medicine, Beijing University of Chinese Medicine, Chinese Academy of Medical Science, Jiangxi University of Traditional Chinese Medicine, and Tsinghua University. The fifth cluster included Chang Gung University, China Medical University, China Medical University Hospital, Tzu Chi University, etc. The sixth cluster included China Pharmaceutical University, Nanjing University of Chinese Medicine, and University of Chicago. The 7th cluster included Fujian University of Traditional Chinese Medicine, Peking University, Second Military Medical University, the 8th cluster included Chinese Academy of Medical Science, Peking Union Medical College, Tianjin University of Traditional Chinese Medicine, and the 9th cluster included Iran University of Medical Science, University of Tehran Medical Science, the 10th cluster included Heilongjiang University of Chinese Medicine, the 11th cluster included Toyama Medical and Pharmaceutical University, and finally, the 12th cluster included Zhejiang Chinese Medical University.

The average publication year for the different organization was also analyzed and visualized (Fig. 6B). In the color bar, blue color indicates earlier publication year and yellow indicates later publication year. The average number of citations for organizations were visualized (Fig. 6C), and blue color indicates fewer citations and a yellow indicates greater number of citations. The second cluster (centered in universities in the USA, represented by Harvard University) included organizations with an earlier publication year and greater number of citations than other clusters (Table 9).

4. Discussions

The current study conducted bibliometric analysis of the research trends of 516 articles published between the year 1991 and August 2021, regarding application of herbal medicine in treatment of RA. The articles varied from cell, animal, and clinical studies to reviews. Based on this analysis, the number of studies related to herbal medicines and RA is showing an increasing trend. The country with the greatest number of publications was People's Republic of China, followed by the USA, South Korea, and India. Previously, most of the studies have been conducted by People's Republic of China and USA, but in the last few years, a lot of studies were conducted in countries like Saudi Arabia and Malaysia. The direction of research in many countries was affected by the USA, People's Republic of China, and South Korea in the beginning, but currently,

Table 3

Clusters of keywords and average publication year and number of citations.

Cluster	Label	Occurrences	Average of publication year	Average of citations
1	Rheumatoid arthritis	188	2015.4	16.5
1	Double-blind	51	2012.7	34.3
1	Osteoarthritis	50	2012.3	24
1	Herbal medicine	47	2013.1	20
1	Arthritis	38	2011.8	20
1	Methotrexate	33	2016	9.7
1	Efficacy	29	2013.1	15.1
1	Traditional Chinese medicine	29	2014.6	18
1	Alternative medicine	22	2013.9	17.1
1	Complementary	17	2015.2	16
1	Management	17	2016.6	11.6
1	Medicine	17	2013.7	14.8
1	Low-back-pain	13	2005.5	41
1	Safety	13	2013	13.5
1	Acupuncture	12	2007	35.7
1	Risk	12	2016.9	9
1	Systematic review	12	2014.9	30.4
1	Complementary and alternative medicine	11	2011.9	26.9
1	Meta analysis	11	2015.4	23.3
1	Pain	11	2012.7	28.6
1	Alkaloids	10	2015.8	11.8
1	Classification	10	2012	20.2
1	Prevalence	10	2011.7	14.9
2	Rheumatoid-arthritis	203	2012.6	19.3
2	Inflammation	85	2015.8	15.2
2	Expression	60	2014.3	18.6
2	Cells	40	2013.1	21.8
2	TNF-alpha	37	2014.76	19.4
2	Cytokines	35	2014.5	16.1
2	In-vitro	31	2014	28.4
2	Therapy	30	2013	20.6
2	Activation	28	2014.4	18
2	Apoptosis	24	2015.4	16
2	Necrosis-factor-alpha	18	2011.1	26
2	Pathogenesis	18	2017.1	11.5
2	Pathway	13	2016.6	17.9
2	Macrophages	12	2015.4	24
2	Proliferation	11	2014.8	10.8
2	Cartilage	10	2013.9	17.2
2	Induction	10	2012.5	22
2	Leflunomide	10	2014.1	16.5
2	Model	10	2015.5	8.4
2	Tumor-necrosis-factor	10	2009.5	17.4
3	Extract	51	2013.3	19.7
3	Inhibition	33	2012	26.3
3	Disease	32	2013.7	16.9
3	Mechanisms	30	2014.9	20.6
3	Rats	26	2012.7	28.9
3	Oxidative stress	25	2017	23.6
3	Mice	19	2011.5	22.6
3	Herbal medicines	18	2015.8	11.3
3	Anti-inflammatory	16	2015.6	19.8
3	Anti-inflammatory activity	15	2015.9	14.6

(Continued)

Table 3

(Continued)

Cluster	Label	Occurrences	Average of publication year	Average of citations
3	Pharmacology	13	2017.3	16
3	Antioxidant	12	2016.5	12.3
3	Anti-inflammation	11	2013.5	41
3	Nitric-oxide	11	2015.3	27.5
3	Cancer	10	2015.9	23.7
3	Chinese herbal medicine	10	2013.4	31.7
3	Constituents	10	2015.9	18.8
3	Flavonoids	10	2016.4	7.8
3	Plants	10	2014.6	20.1
4	Collagen-induced arthritis	74	2014.1	21.6
4	Nf-kappa-b	59	2015.5	25.6
4	Adjuvant-induced arthritis	31	2015.8	23.8
4	Wilfordii hook-f	27	2010.6	33.2
4	Fibroblast-like synoviocytes	23	2017.9	19.3
4	Nitric-oxide synthase	17	2010.6	27.5
4	Tripterygium-wilfordii	16	2009.9	38.6
4	Adjuvant arthritis	15	2010.9	34.6
4	T-cells	15	2012.9	36.2
4	Triptolide	15	2013	36.2
4	Curcumin	10	2016.4	28.6
4	Gene-expression	10	2011.6	31.5
4	Synovial fibroblasts	10	2016.6	23.3
	Cluster 1	28.8	2013.2	20.5
	Cluster 2	34.7	2014.1	18.2
	Cluster 3	19	2014.8	21.2
	Cluster 4	24.7	2013.5	29.2

Nf-kappa-b = Nuclear factor kappa B, TNF = tumor necrosis factor.

Table 4

Distribution of publications by author.

	Author	Records (n)	Percentage (%)
1	Moudgil, KD	15	2.907
2	Lu, AP	14	2.713
3	Liu, J	12	2.326
4	Li, Y	11	2.132
5	Li, J	10	1.938
6	Wang, J	10	1.938
7	Lu, C	9	1.744
8	Wang, CZ	9	1.744
9	Yu, H	9	1.744
10	Kogure, T	8	1.55

countries like Saudi Arabia and Malaysia are conducting studies based on their own interest.

The author who published the greatest number of studies regarding RA and herbal medicine was Moudgil, KD from the University of Maryland (15 articles), followed by Lu, AP from Hong Kong Baptist University (14 articles), Liu, J from Anhui University of Chinese Medicine (11 articles), and Li, Y from Shaanxi Academy of Traditional Chinese Medicine (11 articles). Moudgil et al[18] studied the mechanism of action of herbal medicine on autoimmune arthritis and their interaction with various drugs. Lu, AP broadened the understanding of various factors

that can affect the sensitivity of herbal medical interventions by studying the combined effect of different herbs and their interaction with each other.[19] South Korea has been conducting research on certain pharmacological ingredients extracted from herbs.[20] This information about the authors, organizations, and countries will contribute to cooperation and communication between researchers across the world.

The results of categorizing clusters based on organizations and authors by correlating them with publication year and number of citations indicated that organizations and researchers from the USA and People's Republic of China had an older publication year and were more cited than other countries from other clusters. This may be due to the fact that earlier publications were exposed to researchers for a longer time.

The research themes from the analysis of keywords included 4 clusters: complementary and alternative medicine clusters, mechanism of the pain cluster, control for the pain cluster, and recent research trend cluster. The keywords from the first cluster "complementary and alternative medicine" are "Herbal medicine (47 occurrences)," "Traditional Chinese medicine (29 occurrences)," "Alternative medicine (22 occurrences)," "Complementary (17 occurrences)," "Complementary and alternative medicine (11 occurrences), etc. The second cluster included "mechanism of the pain" were consisted of "Inflammation (85 occurrences)," "Expression (60 occurrences)," "TNF alpha (37 occurrences)," "Cytokines (35 occurrences)," etc. The third cluster comprised of words like "control for the pain" included "Inhibition (33 occurrences)," "Oxidative stress (25 occurrences)," "Anti-inflammatory (16 occurrences)," "Anti-inflammatory activity (15 occurrences),"
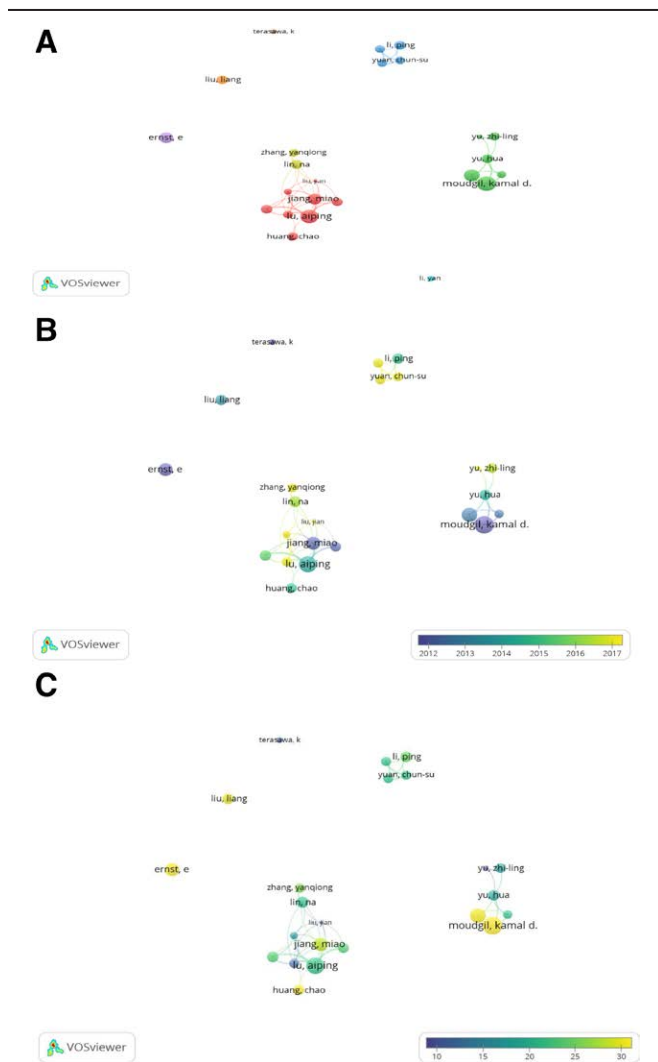
Figure 4. Analysis of authors. (A) The authors of studies on rheumatoid arthritis-related herbal medicine were categorized into 8 groups. (B) Analysis of authors by the average publication year (blue: earlier, yellow: later). (C) Analysis of authors by the average citations (blue: fewer, yellow: more).

Table 5

Analysis for cluster by authors.

	Occurrence	Average publication year	Average citations
Cluster 1	8.2	2015.2	19.6
Cluster 2	7.8	2014.3	23.7
Cluster 3	6.2	2016.2	22
Cluster 4	7	2016.4	23
Cluster 5	9	2002.8	51.6
Cluster 6	5	2016	13.2
Cluster 7	6	2013.5	29.1
Cluster 8	5	2001	12.2

"Antioxidant (12 occurrences)," etc finally, the fourth cluster included "recent research trend" had keywords such as "Collagen-induced arthritis (74 occurrences)," "Nf-kappa-b (59 occurrences)," "Adjuvant-induced arthritis (31 occurrences)," "Wilfordii hook-f (27 occurrences)," "Fibroblast-like synoviocytes (23 occurrences)," and "Nitric-oxide synthase (17 occurrences)." The

Table 6

Distribution of publications by country.

	Country	Records (n)	Percentage (%)
1	People's Republic of China	250	48.4
2	United States of America	82	15.8
3	South Korea	52	10
4	India	44	8.5
5	Taiwan	27	5.2
6	Japan	25	4.8
7	Iran	15	2.9
8	England	14	2.7
9	Germany	14	2.7
10	Australia	12	2.3
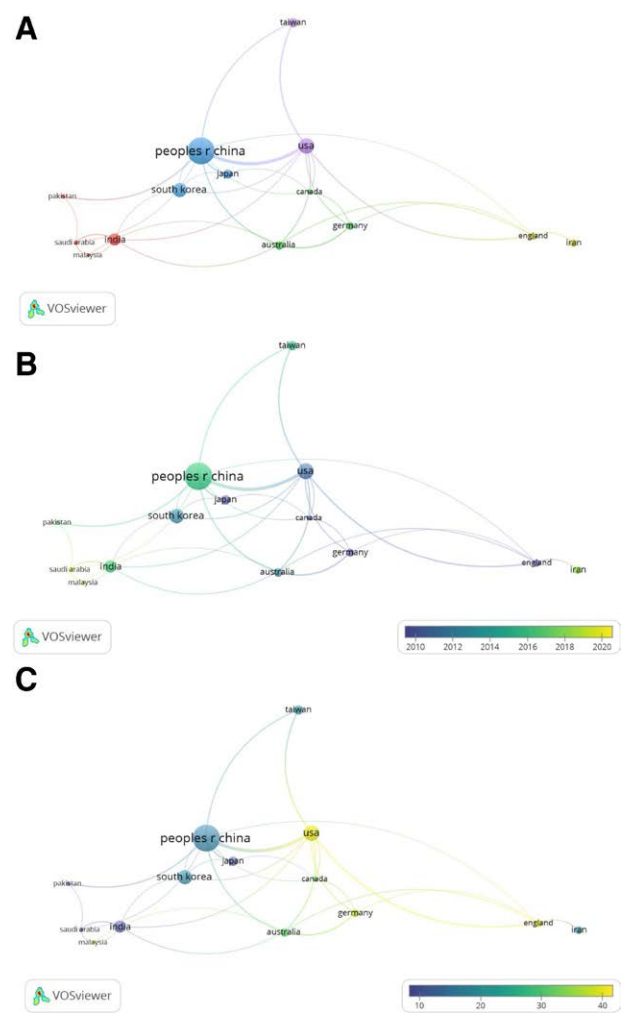
Figure 5. Analysis of nations (A) Different nations that published on rheumatoid arthritis-related herbal medicine were categorized into 5 groups. (B) Analysis of nations by average publication year (blue: earlier, yellow: later). (C) Analysis of nations by the average number of citations (blue: fewer, yellow: more).

characteristics of the 4 clusters were analyzed as follows: the average publication year of cluster 4 (recent research trend) was 2013.5, which is earlier than cluster 2 (mechanism of pain) and 3 (control for pain) but later than cluster 1 (complementary and alternative medicine). The average number of citations in cluster 4 (recent research trend) is

Table 7

Cluster of nations, average publication year, and average citations.

	Occurrence	Average publication year	Average citations
Cluster 1	16	2017.6	14.1
Cluster 2	16	2009.9	24
Cluster 3	100.6	2012	22.9
Cluster 4	17.5	2013.5	25.2
Cluster 5	50.5	2013.2	27

Table 8

Distribution of the publications by organization.

	Organization	Records (n)	Percentage (%)
1	China Acad Chinese Med Sci	33	6.3
2	Hong Kong Baptist Med	27	5.2
3	Univ Maryland	20	3.8
4	China Pharmaceut Univ	18	3.4
5	Kyung Hee Univ	17	3.2
6	Guangzhou Univ Chinese Med	14	2.7
7	Shanghai Univ Tradit Chinese Med	13	2.5
8	Anhui Univ Chinese Med	11	2.1
9	Chinese Med Univ	11	2.1
10	Beijing Univ Chinese Med	11	2.1

29.2, which is higher than that of cluster 1 (complementary and alternative medicine) (20.5), cluster 2 (mechanism of the pain) (18.2), and cluster 3 (control for the pain) (21.2). This identification of this trend can be beneficial for researchers in designing future studies.

There were some limitations in this study. First, this study only analyzed English-written literature from the Web of Science; therefore, it is one sided. If the Chinese or Korean databases were utilized for the analysis, it would have broadened the result, since complementary and alternative medicine is very popular in these countries. However, we intended to focus on a more global database, including most Science Citation Index journals. Second, the number of clusters and their names can vary depending on the researcher. However, this is a unique perspective that makes this study different from the other studies. To raise the objectivity of the naming, authors participated in discussions with many feedbacks.

5. Conclusions

Herein, we analyzed 516 papers on herbal medicine for RA treatment to determine the research trends from 1991 to 2021. Although this study had certain limitations, it showed trends in herbal medicine for RA and presented them to researchers via visual knowledge mapping. First, our analyses revealed that the number of publications increased from 1991 to 2021. Specifically, the greatest number of studies were published in 2020, proving that research was actively conducted during this period. Second, a large number of publications were in journals on phytotherapy and ethnopharmacology. Third, the largest number of articles were published in the People's Republic of China, followed by the USA and South Korea. Fourth, the author who published the most papers and the most frequently co-cited literature was Moudgil, KD. Fifth, the most productive institution in
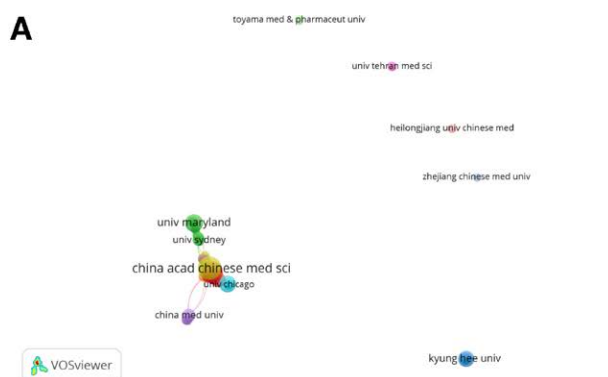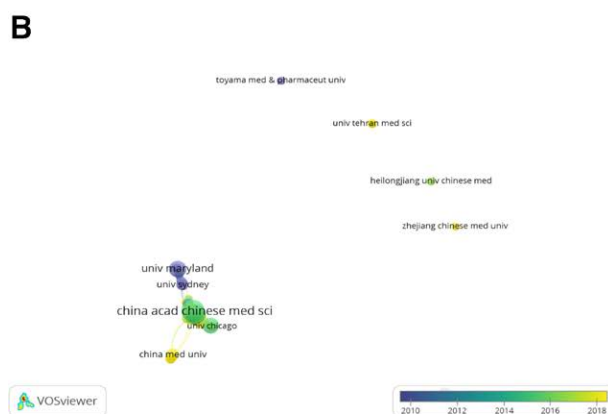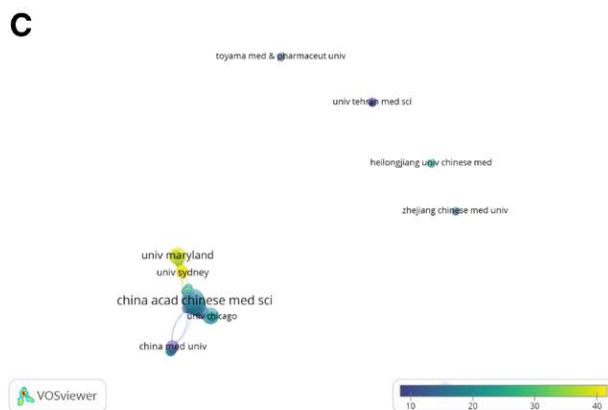
Figure 6. Analysis of organizations (A) The organizations that published studies on rheumatoid arthritis related herbal medicine were categorized into 12 groups. (B) Analysis of organizations by the average publication year (blue: earlier, yellow: later). (C) Analysis of organizations by the average citations (blue: fewer, yellow: more).

terms of publications in this field was the China Academy of Chinese Medical Science, followed by the Hong Kong Baptist University and the University of Maryland. However, the cooperation between institutions was relatively weak. Therefore, cooperation and communication between different research teams should be reinforced to promote the application of herbal medicine in the management of RA. Finally, analysis of keywords showed 4 clusters including complementary and alternative medicine clusters, mechanism of the pain cluster, control for the pain cluster, and recent research trend cluster.

In summary, our results offer useful information, such as potential collaborators, research frontiers, and countries, providing a direction to the developing trends and hot topics in herbal medicine for RA. More rigorous research should be executed in the future.

Table 9

Cluster of organizations, average publication year, and average citations.

	Occurrence	Average publication year	Average number of citations
Cluster 1	10.2	2015.9	16.3
Cluster 2	8.4	2009	39.9
Cluster 3	8	2012.1	20.6
Cluster 4	13	2016.9	12.7
Cluster 5	7.5	2018.6	10.3
Cluster 6	9.6	2016.6	18.6
Cluster 7	6.3	2016.9	28.7
Cluster 8	6.6	2014	25
Cluster 9	5.5	2018.9	7.1
Cluster 10	5	2016.4	23
Cluster 11	5	2001	12.2
Cluster 12	5	2018.2	15

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