




# Traditional herbal medicine: overview of research indexed in the scopus database

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## Abstract

Traditional herbal medicine has been playing an essential role in primary health care globally. The aim of this work is to present an overview of traditional herbal medicine research productivity over the past years. The data was accessed from the Scopus database ([www.scopus.com](http://www.scopus.com)), while VOSviewer, Var1.6.6, Bibliometrix, and R studio were used for further analysis of the obtained data. The results showed that researches on traditional herbal medicine increased annually after 1990, followed by a corresponding increase in global citations during the period, with a total of 22,071 authors contributing to all the publications. Yiling Wang of Shanghai Institute of Drug Control, Shanghai, China was the most productive author (TNP = 303), while Journal of “Evidence-based Complementary and Alternative Medicine”, and “Journal of Ethnopharmacology” were the top ranked journals, respectively. Also, China, Japan, and India were found to be the top Corresponding Author's Countries for researches on traditional herbal medicine, as Beijing University of Chinese Medicine, China Academy of Chinese Medical Sciences and China Medical University were top affiliations. Moreover, National Natural Science Foundation of China, National Key Research and Development Program of China, Ministry of Science and Technology of the People's Republic of China, and Ministry of Science and Technology, Taiwan were top funding agencies, with more than 100 documents. The bibliometric research study has revealed an annual increasing trend in traditional herbal medicine, while also revealing that the topmost ranked authors and funding agencies were from Asia especially China.

**Keywords** Traditional herbal medicine · Bibliometric analysis · Scopus · Research productivity

## Introduction

Traditional herbal medicine (or alternative herbal medicine) has played an essential role as a source of primary health care for many, globally (Maroyi and Cheikhoussef

2015), as it has maintained the health of majorly Africans and Asians for thousands of years with a unique medical system built based on empirical- and accumulated knowledge. It has been reported that ~70–80% of Africa's emerging urban and rural population rely on traditional herbal

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medicine for health intervention (Hostettmann et al. 2000; Lee et al. 2019), and even at the moment, billions of people around the world are taking traditional herbal medicine daily in form of food, drugs or supplements (Aydin et al. 2016). Traditional herbal medicine have been reported to have been used to cure or prevent many diseases and ailments including gastroesophageal reflux disease (Dai et al. 2020), prevents postoperative recurrence of small hepatocellular carcinoma (Zhai et al. 2018), adjuvant for chemo- and radiotherapy for cancer (Qi et al. 2010), adjunctive therapy for nasopharyngeal cancer (Kim et al. 2015), resectable gastric cancer (Lee et al. 2018), treatment of viral infections, stress and anxiety as well as improve mental health during Covid-19 pandemic (Shahrajabian et al. 2021; Yu et al. 2020), just to mention a few. Therefore, sustainable management towards traditional herbal medicine, the reactions, and challenges in the monitoring and safety of plant resources are essential sources of new drugs development which are used in treating several diseases ranging from general body pain to complicated diseases in humans (Kutalek and Prinz 2005; Maroyi and Cheikhoussef 2015).

Bibliometric analysis has been used in many fields including Covid-19 and mental health (Akintunde et al. 2021), gum arabic (Musa et al. 2021a), neem (Onasanya et al. 2022) and in diseases such as sickle cell anemia (Musa et al. 2021b), anticancer research using herbal medicine (Basu et al. 2017), herbal medicine for pain (Wang and Meng 2021), medical treatment of cardiovascular diseases (Huang et al. 2016), and natural products against cancer (Du and Tang 2014). The findings from these studies have helped researchers to explore new directions for future research while also playing a fundamental role in decision making regarding policy, in addition to identifying new perspectives on potential collaborations in these fields (Basu et al. 2017; Du and Tang 2014; Huang et al. 2016; Musa et al. 2021a, 2021b; Wang and Meng 2021). However, there is yet any bibliometric analysis reportedly conducted to enhance the understanding of research hotspots, frontiers, and trends in the traditional herbal medicine indexed in the Scopus, as this will initiate a focus on future researches and identify gaps, hence assist to explore current patterns and trends in literatures (Dol et al. 2021). Furthermore, using bibliometric analysis will enable researchers have a good grasp of the basic characteristics of the publications done over the years with empirical evidence on traditional medicine.

Therefore, in order to identify and further promote the growth and development of traditional herbal medicine, we used Bibliometric analysis to analyse all the published literatures therein. This technique can draw the primary bibliometric landscapes of the development of topics, highlighting the most active authors, influential countries or regions, top-most research interests in the fields and the hot topics covered over the past years, in addition to the international and

national collaboration networks among authors, countries or regions. Hence, this paper aims to establish via analysis, the research productivity on the traditional herbal medicines indexed in the Scopus database, while assessing the research gaps by reviewing the published literatures.

## Materials and methods

### Sources of data

A bibliographic data acquisition was carried out using the Scopus database (<https://www.scopus.com/>) updated to March 2, 2022. Scopus is a world leading scientific database widely known for its extensive database of abstracts and citations which offers researchers the most comprehensive literature (covering all fields of natural sciences, medicine, social sciences and life sciences) retrieval.

### Search strategy

We developed our search by examining related publications on traditional herbal medicine using the following query with the corresponding search approach based on:

TITLE ("traditional herbal medicine") OR TITLE ("Herbal medicine") OR TITLE ("herbal drug") OR TITLE ("Traditional Chinese medicine") OR TITLE ("Chinese medicine") OR TITLE ("Persian medicine") OR TITLE ("traditional Iranian medicine") OR TITLE ("Ayurveda") AND (EXCLUDE (PUBYEAR, 2022) OR EXCLUDE (PUBYEAR, english AND limit-to AND doctype)) AND (LIMIT TO (DOCTYPE, "ar")) AND (LIMIT TO (LANGUAGE, "English")).

To ensure the high quality and academic nature of the literatures, only full research articles published in English were included. Initially, the search query returned 10,163 documents and the authors thereafter screened the titles of these articles for relevance. The total extracted documents were harvested after retrieval and saved as Bib format, CSV format, and RIS format for further analysis using the bibliometric tool to run the frequency and generating, visualizing, and analyzing the maps. Two authors (THM and HHM) used bibliometric techniques to set a protocol to retrieve and collect reliable and relevant publications on traditional herbal medicine, as shown in **Fig. 1**. More also, the research category and organisations which enhanced the research productivity over the years were manually retrieved, while the quality of publication was assessed by calculating author's or journal's H-index (Fassin and Rousseau 2019; Garfield et al. 2006). The Journals' impact factor (IF) for the year 2020 was also considered for visualising analysis results by using two bibliometric visualization tools (Garfield et al. 2006).

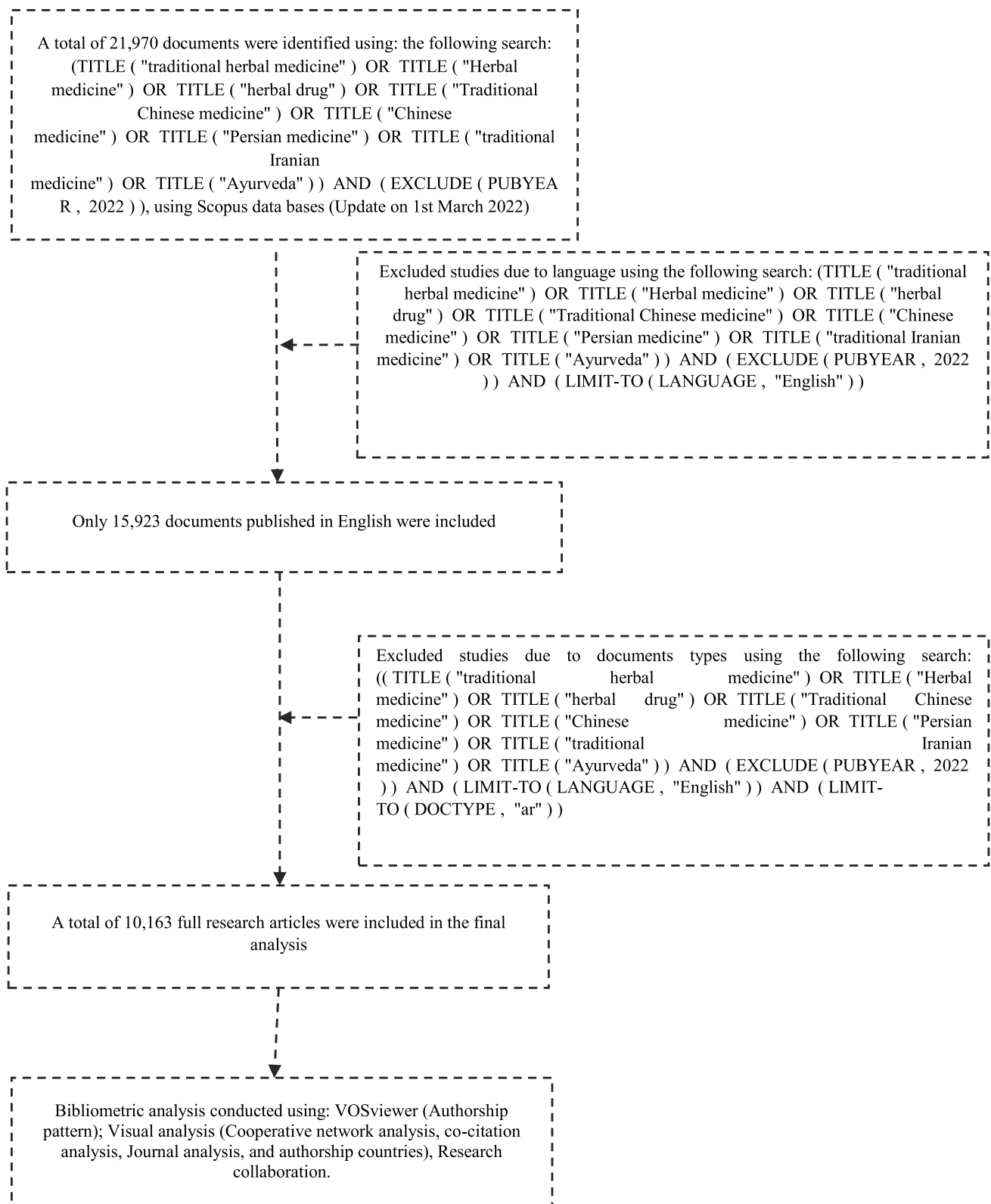


Fig. 1 The inclusion and exclusion process on traditional herbal medicine related-publications

## Data analysis analysis

Bibliometric data were presented using descriptive mapping analysis via VOSviewer, while Var1.6.6 was used for developing, constructing and viewing the bibliometric maps analysis by the unit of co-occurrence analysis, co-citation and bibliographic coupling to examine the length (L) or total length strength (TLS) occurrences or reports between authors, keywords in the titles, abstracts, organizations and countries within the distributed clusters (van Eck and Waltman 2010). Also, bibliometrix and a R package were used to perform the comprehensive bibliometric science mapping analysis (Dervis 2019).

## Results

### Basic characteristics of global publication analysis

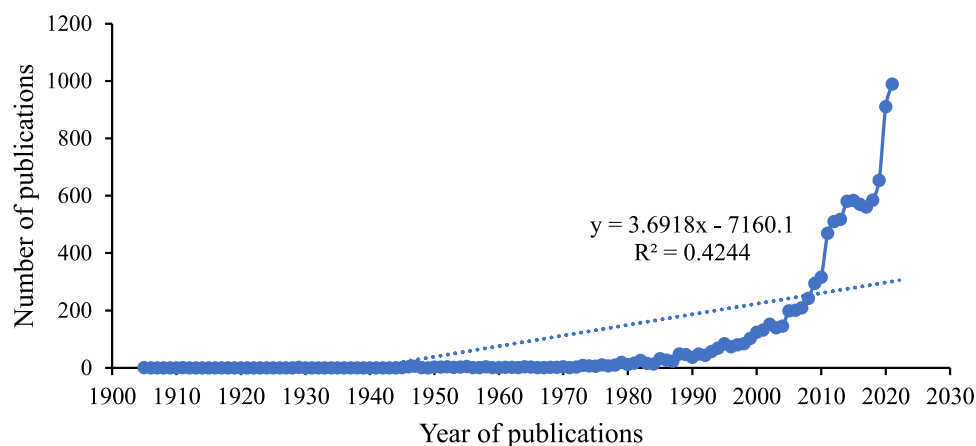
In total, 10,163 articles met the criteria of articles published during year 1909 to 2021. It was observed that there was an annual increase in the number of publications after the

year 1990 (Fig. 2). Of the 10,163 publications, an average of 15.09 citations per documents were found in 2552 Journals, which involved 22,071 authors with 2.34 Collaboration Index (CI) (Table 1).

### Analysis of 10 top highly-cited documents

The recognition of a document on traditional herbal medicine can be reflected by the number of times it is cited, as presented in Table 2, on the descriptive analysis of the top 10 articles that have been published on the domain per citation during the years of investigation. An article titled “TCMSP: a database of systems pharmacology for drug discovery from herbal medicines” which was published in the Journal of Cheminformatics by Ru JL et al. (Ru et al. 2014) received the top-ranked cited article with 1346 citations and 149.5556 Total Citations Per Year. This was followed by the article “Some traditional herbal medicines, some mycotoxins, naphthalene and styrene, published with World Health Organization International Agency for Research On Cancer (WHO–IARC 2002) which received 774 citations and 36.8571 Total Citations Per Year (Table 2).

**Fig. 2** Year-wise distribution of number of publications, 1905–2021



**Table 1** Primary information of metadata

Description	Results	Description	Results
Timespan	1905:2021	Number of corresponding author Country	94
Sources (Journals, Books, etc.)	2552	Authors	
Documents	10,163	Authors	22,071
Average years from publication	10.5	Author Appearances	55,543
Average citations per documents	15.09	Authors of single-authored documents	828
Average citations per year per document	1.449	Authors of Multi-authored documents	21,243
References	301,048	Authors collaboration	
Document types		Single-Authored documents	1077
Article	10,163	Documents per Author	0.46
Document contents		Authors per Document	2.17
Keywords Plus (ID)	43,706	Co-Authors per Documents	5.47
Author's Keywords (DE)	17,887	Collaboration Index	2.34

**Table 2** Top 10 Cited Papers of traditional herbal medicine

Documents title	Total Citations	TC per Year	Normalized TC
TCMSP: a database of systems pharmacology for drug discovery from herbal medicines	1346	149.5556	77.4667
Some traditional herbal medicines, some mycotoxins, naphthalene and styrene	774	36.8571	25.0956
Traditional Chinese medicine network pharmacology: theory, methodology and application	662	66.2000	33.0936
TCM Database	528	44.0000	25.2017
Taiwan: the world's largest traditional Chinese medicine database for drug screening in silico			
Heavy metal content of ayurvedic herbal medicine products	473	24.8947	12.3844
The scientific rediscovery of an ancient Chinese Herbal medicine: Cordyceps sinensis: part I	401	16.0400	12.5874
Chromatographic fingerprint analysis—a rational approach for quality assessment of traditional Chinese herbal medicine	394	23.1765	11.8678
Treatment of irritable bowel syndrome with Chinese herbal medicine: a randomized controlled trial	358	14.3200	11.2377
New Perspectives on How to Discover Drugs from Herbal Medicines: CAM's Outstanding Contribution to Modern Therapeutics	343	34.3000	17.1467
<i>Effect of Chinese Medicine Alpinetin on the structure of human serum albumin</i>	331	18.3889	10.5644

### Journal analysis and quality of the publication

A total of 2552 journals were involved in the publication of traditional herbal medicine researches indexed in the Scopus database. The analysis revealed that the Journal of “Evidence-based Complementary and Alternative Medicine” was the topmost productive journal (h\_index = 32, TNP = 401), followed by Journal of Ethnopharmacology (h\_index = 57, TNP = 359) and then Chinese Journal of Integrative Medicine (h\_index = 18, TNP = 253) as presented in Table 3.

### Evaluation of scientific research by geographical area

In the evaluation of the scientific output based on geographical area, it was found that ninety-four (94) Corresponding Author's Countries contributed to the traditional herbal medicine-based published works, out of which only the top 10 most productive countries were listed in Table 4. People's Republic of China was revealed to be the most productive

(TNP = 4585), followed by the Japan (TNP = 730), India (TNP = 485), USA (TNP = 479) and Korea (TNP = 339), respectively. Meanwhile, the highly cited countries revealed that China is the topmost with reported 67,287 citations at an average citation of 14.675, followed by Japan with 14,372 citations at an average of 19.688 citations and then United States of America with 13,011 at an average of 27.163 citations, while Germany (3163 citations at an average of 27.991 citations) and Iran (1848 citations at an average of 9.625 citations) are coming from the rear back, on traditional herbal medicine-based researches published during the study period.

### Authors productivity and co-authorship analysis

On the authors' productivity, a total of 22,071 authors have been revealed to have contributed to traditional herbal medicine publications within the study period. The analysis of the top 10 authors shows that Yiling Wang from Shanghai Institute of Drug Control, Shanghai, China has the highest

**Table 3** Top 10 Journal on sources with more than 100 articles

Journal sources	h_index	TC	TNP	IF (2020)
Evidence-based Complementary and Alternative Medicine	32	5163	401	2.629
Journal of Ethnopharmacology	57	11,543	359	4.36
Chinese Journal of Integrative Medicine	18	2131	253	1.978
American Journal of Chinese Medicine	30	3360	172	4.667
BMC complementary and alternative medicine	29	2953	136	3.659
Journal of alternative and complementary medicine	28	2821	126	2.579
Complementary Therapies in Medicine	23	1858	113	2.446
Journal of pharmaceutical and Biomedical Analysis	37	3629	107	3.935
Journal of Chinese Integrative Medicine	12	568	106	1.978
Journal of Traditional Chinese Medicine	12	691	95	0.848

TNP: Total Number of Publication

**Table 4** Top 10 most Corresponding Author's Country and Most Cited Countries

Country (n=94)	Corresponding author's country					Most cited countries		
	Articles	Freq	SCP	MCP	MCP_Ratio	Country	TNC	AAC
China	4585	0.53	3981	604	0.1317	China	67,287	14.675
Japan	730	0.08	658	72	0.0986	Japan	14,372	19.688
India	485	0.05	458	27	0.0557	USA	13,011	27.163
USA	479	0.06	342	137	0.2860	Hong Kong	7102	21.327
Korea	339	0.04	312	27	0.0796	India	6382	13.159
Hong Kong	333	0.04	217	116	0.3483	Australia	3931	20.056
Australia	196	0.02	134	62	0.3163	United Kingdom	3877	21.904
Iran	192	0.02	179	13	0.0677	Korea	3543	10.451
United Kingdom	177	0.02	129	48	0.2712	Germany	3163	27.991
Germany	113	0.01	70	43	0.3805	Iran	1848	9.625

AAC: Average Article Citations; TNC: Total Number of Citations; SCP: Single country publications; MCP: Multiple country collaboration

contribution with 303 published articles and an H\_index of 39, followed by Zhang Y of Yunan University of Chinese Medicine College with 228 published documents and an H\_index of 27, among other reported authors, as given in Table 5.

### Top subject areas and funding sponsors for research on traditional herbal medicine

In order to analyse the key subject areas in relation to traditional herbal medicine, most of published articles were indexed in field of Medicine (6005; 38.0%), Pharmacology, Toxicology and Pharmaceutics (2607; 16.5%), Biochemistry, Genetics and Molecular Biology (1885; 11.9%), Chemistry (1341; 8.5%), Agricultural and Biological Sciences (552; 3.5%), Nursing (343; 2.2%), Immunology and Microbiology (337; 2.1%), Chemical Engineering (320; 2.0%), Environmental Science (277; 1.8%), Health Professions (273; 1.7%),

amongst other subject areas (Fig. 3). Moreover, majority of research fundings emanated from National Natural Science Foundation of China, National Key Research and Development Program of China, and Ministry of Science and Technology of the People's Republic of China. Furthermore, Beijing University of Chinese Medicine, China Academy of Chinese Medical Sciences, China Medical University, and Shanghai University of Traditional Chinese Medicine were amongst the top listed affiliations (Table 6).

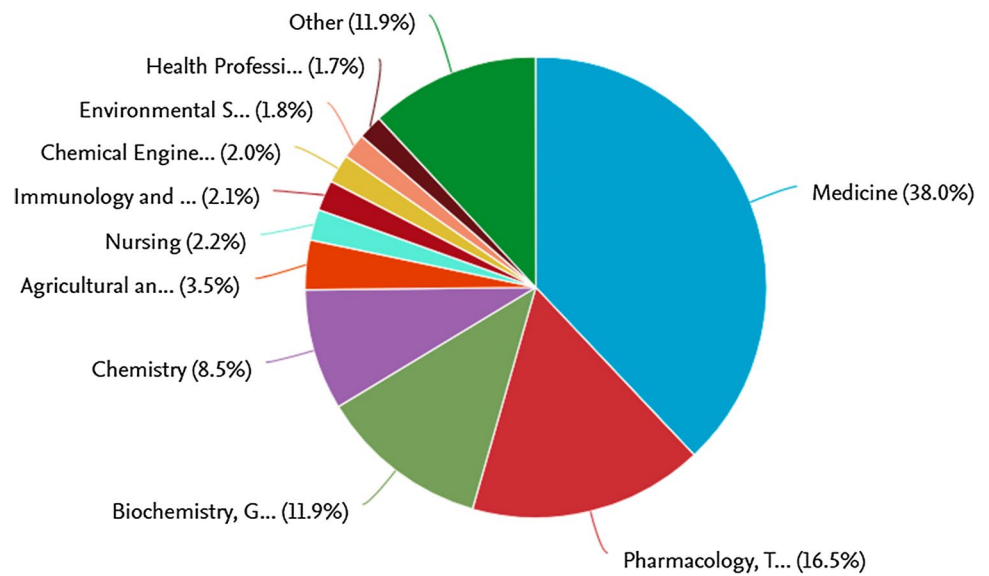
### Co-occurrence analysis

The network visualization of co-occurrence indicates the frequency number of a keyword that appeared to determine the hot topics, while the color of each point on the map represents the density of the term over the past years, and the color represents the cluster. Also, the lines between the items represent the links. All Keywords (the minimum number of

**Table 5** Top 10 most productive authors

Element	Affiliations	h_index	TC	TNP
Yiling Wang	Shanghai Institute of Drug Control, Shanghai, China	39	7159	303
ZHANG Y	Yunnan University of Chinese Medicine Coll Chinese Mat Med	27	2946	228
Yan-Da Li	he Key Laboratory of Bioinformatics of Ministry of Education, Institute of Bioinformatics, Tsinghua University, Beijing	32	4972	198
Jong-JingWang	Graduate Institute of Bio-Pharmaceutical Science, National Yang-Ming University, Taipei, Taiwan	27	4218	191
Yi-Chu Liu	National Laboratories of Foods and Drugs, Department of Health, Executive Yuan, Taiwan	25	2393	171
Xian Li	Shenyang Pharmaceutical University, Shenyang, 110,016, China	27	2703	154
Jianqing Zhang	Department of Pharmacy, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430,030, China	25	2214	152
Xiao-ru Wang	Chemistry Department, Xiamen University, Xiamen, P.R. China	28	2926	151
Ji-Cheng Li	Yunnan University of Chinese Medicine Coll Chinese Mat Med Kunming, Yunnan, China	22	1575	141
Xiao-Jing Zhang	Department of Pediatrics and Center for Cardiovascular Sciences, Albany Medical College, Albany, New York	24	2470	138

TNP: Total Number of Publication; TC: Total Citations

**Fig. 3** Subject area on traditional herbal medicine**Table 6** Statistics of top 10 funding Sponsor and Affiliation or university contributed on traditional herbal medicine

Affiliation	Documents	Funding sponsor	Documents
Beijing University of Chinese Medicine	466	National Natural Science Foundation of China	1376
China Academy of Chinese Medical Sciences	408	National Key Research and Development Program of China	188
China Medical University	335	Ministry of Science and Technology of the People's Republic of China	172
Shanghai University of Traditional Chinese Medicine	313	Ministry of Science and Technology, Taiwan	101
Ministry of Education China	274	Ministry of Education of the People's Republic of China	97
Chinese Academy of Sciences	251	Ministry of Health and Welfare	95
China Medical University Hospital	227	National Institutes of Health	95
Chinese University of Hong Kong	216	China Postdoctoral Science Foundation	84
Guangzhou University of Chinese Medicine	182	Fundamental Research Funds for the Central Universities	84
Chengdu University of Traditional Chinese Medicine	171	China Medical University Hospital	74

occurrences of keyword with over 300) were selected, as only 81 Keywords met the threshold and were included in the network analyses, which show different occurrences of the topic as organized into three (3) clusters with links and total link strength given between the keywords ( $L=3118$ ,  $TLS=521,963$ ), as shown in (Fig. 4A).

### Co-author networks analysis among authors, organizations, and countries or regions

Based on a threshold of 10, the minimum number of documents for an author was selected, yielding a total of 47 organizations (Fig. 4B), which were thereafter organized into 5 distinct groups/clusters with links and total links strength ( $L=77$ ,  $TLS=346$ ), while countries were organized into 7 clusters with links and total links strength ( $L=420$ ,  $TLS=2285$ ), as shown in Fig. 4C.

## Discussion

Bibliometrics has played a significant role in influencing policymaking as well as presenting a better understanding of scientific fields (Akintunde et al. 2021; Onasanya et al. 2022). The data for this study were retrieved from Scopus because the database provides different  $h$ -index ratings for authors who will need them to track citations and determine the impact of their publications (Musa et al. 2021c). The total number of traditional herbal medicine related-publications has been increasing annually since the year 1990, as traditional herbal medicine has gained attractive attention due to easy accessibility, affordability, safety, promising efficacy, and being environmentally benign (Musa et al. 2021d; Shahrjabin et al. 2019). Their essential roles in public health have led many people of different nationalities to rely on traditional herbal



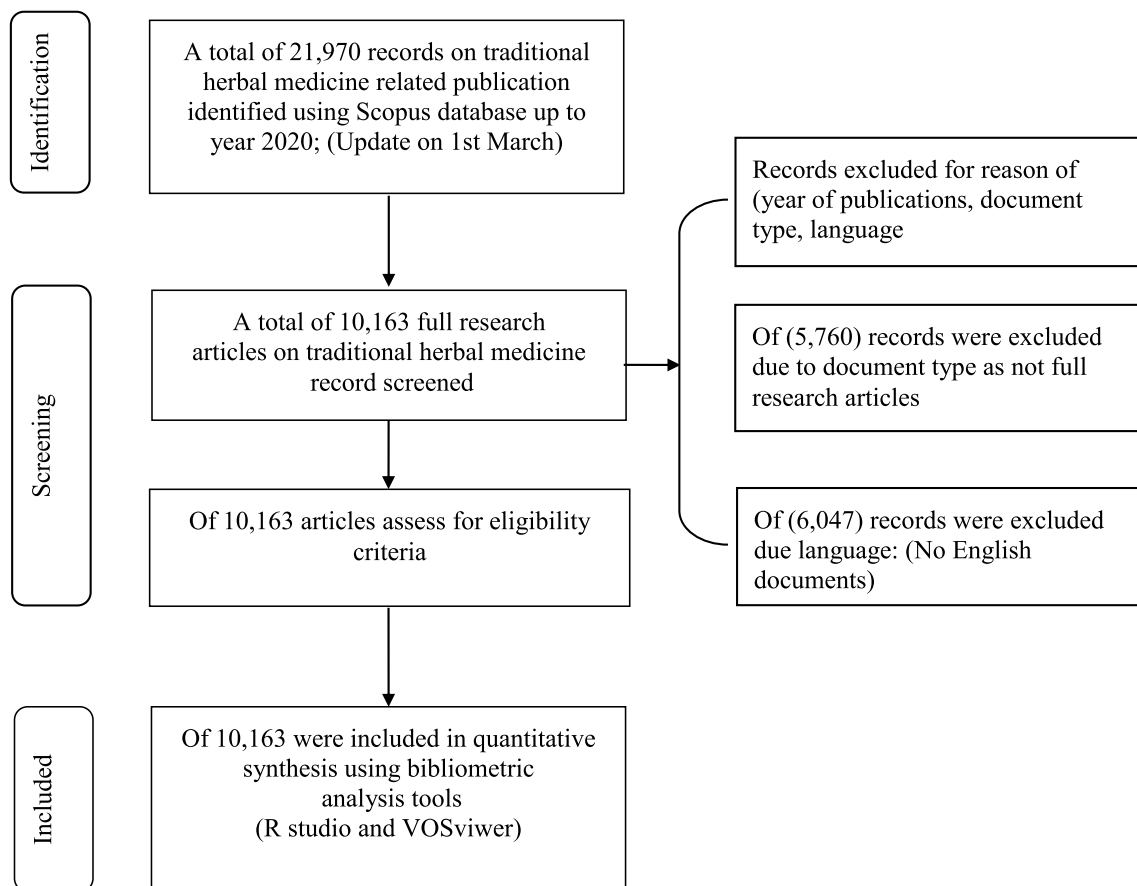


medicines (Soleymani and Shahrajabian 2018), as many herbs and plants included in several traditional systems have promising bioactive compounds for modern drug therapy (Shahrajabian et al. 2020) (Fig. 5).

The recognition of a document on traditional herbal medicine can be reflected by the number of times it is cited as presented in Scopus and other databases. “TCMSP: a database of systems pharmacology for drug discovery from herbal medicines” (Ru et al. 2014) and “Some Traditional Herbal Medicines, Some Mycotoxins, Naphthalene and Styrene” (WHO–IARC 2002) were reported to have being the most influential documents, with the highest number of total citations, as the research of J. Ru and coworkers (Ru et al. 2014) focussed on drug discovery from herbal medicines.

The analysis of journals based on h\_index, total citations, number of documents, and Journal impact factors for the year 2021, revealed that Evidence-Based Complementary and Alternative Medicine, Journal of Ethnopharmacology and Chinese Journal of Integrative Medicine were the top-most ranked journals, based on their total number of publications, total citations and h\_index, as these journals are more concentrated in traditional herbal medicines.

Also, the total number of traditional herbal medicine-focused publications generated 94 countries, with China, Japan, India and the USA being the topmost ranked countries in that order. This is in addition to the top 10 most productive authors coming only from China. This is of no coincidence as China is a reservoir of various high-valued medicinal plants, which have been used in the cosmetics, nutraceutical and pharmaceutical industries (Sun and Shahrajabian 2020). Increasing the research productivity in China is an indicator of the previous published reports that highlighted that herbal medicine is an essential part of traditional medicine which is part of Chinese culture. Moreso, traditional herbal medicine has been in practise in China for thousands of years (Fabricant and Farnsworth 2001). Due to the importance of traditional chinese herbal medicine in Chinese culture, Beijing University of Chinese Medicine and the Chinese Academy of Chinese Medical Sciences were the highest ranked in Organizations-enhanced traditional herbal medicine researches, as the top ten affiliations based on traditional herbal medicines were mainly Chinese domiciled, while the other developing countries are still lagging in conventional herbal medicine research productivity, although most developing countries depend on



**Fig. 5** Prisma flow diagram of the inclusion and exclusion process of the on traditional herbal medicine related-publications

conventional herbal medicine to treat many diseases (Sen and Chakraborty 2017). The lagging in traditional herbal medicine-based researches in most developing countries could be attributed to fewer funding agencies that support scientific researches with grants. The results further revealed that the top ranking authors were Yiling Wang, Zhang Y, Yan-Da Li and Jong-Jing Wang, while Beijing University of Chinese Medicine, Chinese Academy of Chinese Medical Science, China Medical University and Shanghai University of Traditional Chinese Medicine, all based in China, were top ranking organizations. Furthermore, the cooperation networks facilitated by the creation of a database for storing a large portion of the data and their transformation into valuable information, has effectively contributed to the progress of the traditional medicine information system (Noraziah et al. 2011). Noteworthy, China's Comprehensive Herbal Medicine Information System for Cancer has served as an appropriate information resource for traditional medicine researchers (Fang et al. 2005), while Web-based Decision Support System for Prescription in Herbal Medicine could play a significant role in controlling the quality of the herbal drugs prescriptions. Also, developed for consulting with the patients in the e-health system, e-health Record System in Australia has successfully assisted traditional medicine practitioners in the treatment management (Bjering et al. 2011). Although, there are some limitations as we have only included documents published in English language, while only one database, Scopus was used even though other databases such as Web of Sciences (WoS), Embase, PubMed, and Google scholar have also contributed extensively in the coverage of traditional herbal medicine researches.

## Conclusions

The current study is the first bibliometric analysis of traditional herbal medicine scientific researches and publications. The study has shown an increasing publishing trend in recent years, in addition to identifying the global patterns of research, which serves as a tool in supporting the decisions and policies in traditional medicine. However, there is a need to increase research activities and international collaborations, particularly in developing countries as the present world system has been pushing for green and natural products rather than the synthetic ones.

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## Declarations

**Ethical approval** This article does not contain any studies involving animals performed by any of the authors. This article does not contain any studies involving human participants performed by any of the authors.

**Conflict of interest** Hassan Hussein Musa has no conflict of interest. Taha Hussein Musa has no conflict of interest. Olayinka Oderinde has no conflict of interest. Idris Hussein Musa has no conflict of interest. Omonike Olatokunbo Shonekan has no conflict of interest. Tosin Yinka Akintunde has no conflict of interest. Abimbola Kofoworola Onasanya has no conflict of interest.

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