

Ethnopharmacology Research: A Scientometric Assessment of Indian Publications During 2011 to 2020

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Abstract

The current research has been conducted to study the ethnopharmacology research output in the past 10 years (2011–2020) after using Web of Science (WoS) database. The present study has used WoS database to collect the ethnopharmacology research output for the specific period. The retrieved data were analyzed using specific parameters. This study investigates the impact of the most productive institutes, countries, authors, subjects, sources, and keywords. For visualizing purposes, VOSviewer has been used. We retrieved 7,159 papers from WoS, consisting of 84.24% journal articles and 14.23% review articles. The data analysis indicates that consistent growth with increasing multiauthorship is a general trend of research. The Council of Scientific Industrial Research (CSIR) India collaborates with the Indian Council of Agricultural Research (ICAR) and Central Institute of Medicinal Aromatic Plants (CIMAP) in terms of domestic collaboration.

Keywords

Ethnopharmacology research, Scientometric assessment, Research output, India

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Introduction

Ethnopharmacology is a multidisciplinary field of inquiry investigating the anthropological rationale and the pharmacological basis of the medicinal use of plants, animals, fungi, microorganisms, and minerals by human cultures.¹ Ethnopharmacology is a connected investigation of ethnic gatherings and their utilization of plant compounds. It is connected to therapeutic plant use and ethnobotany, a wellspring of lead compounds for drug disclosure. Accentuation has, for quite some time, been on daily medications, albeit the methodology likewise has demonstrated value to the investigation of present-day drugs. Ethnopharmacology is an essential discipline for developing new medicines that are extremely important for the conservation and enhancement of the traditional use of natural products and undoubtedly is one of the primary sources for the rational development of new medicines.

Related Studies

As already mentioned, many studies have been found to conduct a bibliometric and scientometric assessment of

research on ethnopharmacology research. Ragavan et al.¹ performed a scientometric study comparing authors' productivity and citations from different institutions at the national level during 1973 to 2009 using the Web of Science (WoS) database. A total of 1,265 publications were published nationally. This article indicates that the trend towards collaborative research is increasing. Whereas Mueen and Gupta² published a paper on India's antioxidants research publications using various bibliometric indicators during 2001 to 2010 from Scopus database. Many researchers have also explored studies relevant to medicinal plants.^{3–14} This study identified India's contribution in international collaboration documents at the national level

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and key partners in international collaboration, further analyzing the characteristics of institutions, authors, frequently cited articles, etc.

A scientometric study determined the contribution of Indian researchers to foreign journals (*PLOS One*). The data was searched in WoS database, from 2012 to 2016. A total of 133,897 articles were published during the period, of which 3,174 (2.37%) articles belonged to India. Data analysis showed that most participants were from developed countries, except for Brazil and India, which accounted for 2.95% and 2.37%, respectively. This study identified CSIR as the topmost institution in India. The writing style has also shown that Indian scholars tend to write together.¹⁵

Puttannanavar and Bagalkoti¹⁶ examined Indian plant research on various criteria including research growth, research relevance in significant journals, the geographical distribution of journals, the proportion of international core journals, both national and thematic, and characteristics of high-performing institutions and authors. This study used the WoS database, focused on India's published articles during the period 2008 to 2017. Study proposed to build scientific capacities, competencies, and knowledge bases to bridge the scientific and technological gap with leading countries.

Yeung et al.¹⁷ conducted a bibliometric study on research meandering between medicine and food science using the Scopus database. This study identified and analyzed 100 articles in ethnopharmacology. The field has been indexed for 50 years and, although traditionally often associated with “traditional knowledge,” drug discovery, and some areas of pharmacology, this analysis underscores its growing

importance in disease prevention (food science). It further studies the development of research-oriented needs and interests of high-growth economies, especially in Asia.

Materials and Methods

The data analyzed in this work have been obtained through a query in the WoS database, which has been successfully used in many bibliometric studies.¹⁸ It is a study on ethnopharmacology research in India from 2011 to 2020 based on data from the WoS database taking the bibliometric data such as title, author, year, affiliation, and document type. Because of many results, it was necessary to use the WoS, whose methodology has been developed in previous works, to download the data. In this study, the query used was as follows: TS = (ethnopharmacology OR ethnopharmacological OR ethnobotany OR ethnobotanical OR ethnomedicine OR ethnomedical OR medicinal plant OR folk medicine OR traditional medicine OR pharmacognosy). An outline of the methodology used is shown in Figure 1. The analysis of the scientific communities both in terms of keywords and the relationship between authors or between countries was done with the VOSviewer.

Analysis and Results

Year-Wise Publication Output

Table 1 shows the year-wise publication output. India has published 7,159 publications from 2011 to 2020. The annual

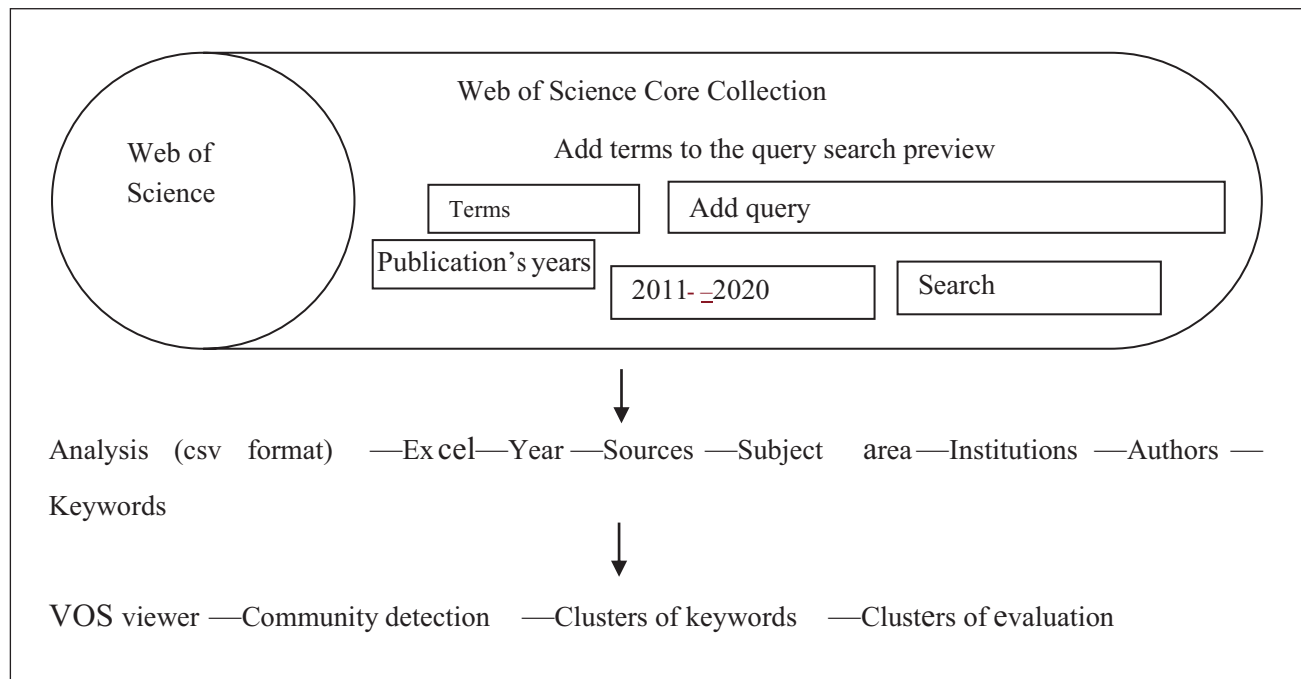


Figure 1. Methodology.

Source: Based on WoS database.

average growth rate of publications output was 10%, as seen from its publications output data for 2011 to 2020. Based on publications, output data during the study period was found to be improved. In 2014, publication growth decreased and the highest journals, 982 (13.717%) were published in 2020. In

terms of citations for total publications during 2011 to 2020, the highest (16,980) was counted in 2011, followed by 2012 (14,950), and 2013 (13,545) estimated respectively. The most minor citations (5,253) were counted in 2020.

Table 1. Year-Wise Publications Output on Ethnopharmacology Research During 2011 to 2020

S. No.	Publication Years	Total Publications	% of 7,159	Total Citations	ACP	h-Index
1	2011	751	10.490	16,980	22.61	55
2	2012	680	9.499	14,950	21.99	54
3	2013	652	9.107	13,565	20.81	52
4	2014	631	8.814	11,841	18.77	47
5	2015	689	9.624	11,917	17.3	50
6	2016	663	9.261	9,754	14.71	41
7	2017	672	9.387	9,332	13.89	38
8	2018	708	9.890	8,332	11.77	40
9	2019	731	10.211	6,681	9.14	35
10	2020	982	13.717	5,253	5.35	28
—	—	7159	100			

Source: Based on WoS database.

Table 2. Subject-Wise Publications on Ethnopharmacology Research from 2011 to 2020

S. No.	Web of Science Categories	Record Count	% of 7,159
1	Plant sciences	1880	26.261
2	Pharmacology pharmacy	1640	22.908
3	Chemistry medicinal	1172	16.371
4	Integrative complementary medicine	920	12.851
5	Biochemistry molecular biology	561	7.836
6	Biotechnology applied microbiology	548	7.655
7	Multidisciplinary sciences	349	4.875
8	Food science technology	344	4.805
9	Agronomy	275	3.841
10	Chemistry multidisciplinary	239	3.338
11	Biology	203	2.836
12	Microbiology	199	2.78
13	Environmental sciences	185	2.584
14	Chemistry applied	182	2.542
15	Medicine research experimental	181	2.528
16	Cell biology	170	2.375
17	Toxicology	161	2.249
18	Agricultural engineering	159	2.221
19	Chemistry analytical	159	2.221
20	Genetics heredity	139	1.942
21	Medical laboratory technology	134	1.872
22	Immunology	113	1.578
23	Public environmental occupational health	107	1.495
24	Biophysics	106	1.481
25	Parasitology	102	1.425
—	165 subjects	—	—

Source: Based on WoS database.

Subject-Wise Distribution of Publications

According to WoS data, “ethnopharmacology research” in India is interconnected with 165 disciplines. Of these, Table 2 shows the top 25 subject disciplines. The plant sciences, pharmacology, pharmacy, chemistry, medicinal and integrative complementary medicine have been the preferred areas of research (with a share of 78.4%), followed by biochemistry, molecular biology, biotechnology, applied microbiology, multidisciplinary sciences, food science technology, agronomy, and chemistry multidisciplinary; these disciplines have contributed between 3% and 8% of total publications and the remaining 15 disciplines contributed to less than 3% of the total publications. In four fields, the activity index registered a significant rise, whereas it registered a significant decline in six other disciplines. In 15 different areas, the reduction in activity index was marginal.

Profile of Top 25 Journals in Ethnopharmacology Research During 2011 to 2020

Table 3 illustrates the top 25 journals. In the journal ranking by research productivity in ethnopharmacology research in India, it was seen that the top 25 most productive journals accounted for a 34% share during 2011 to 2021. *Journal of Ethnopharmacology* is the top-ranking productive journal (with 522 papers in ethnopharmacology), followed by *Indian Journal of Traditional Knowledge* (238 papers), *Industrial Crops and Products* (159 papers), *Pharmaceutical Biology* (132 papers), *Pharmacognosy Magazine* (112 papers), *PLOS One* (132 papers), *Biomedicine Pharmacotherapy*, and *Natural Product Research* (76 papers each, etc. In terms of *h-index* performance, *PLOS One* registered the highest *h-index* (332), followed by *Scientific Reports* (213), *Journal*

Table 3. Profile of Top 25 Journals in Ethnopharmacology Research During 2011 to 2021

S. No.	Name of the Journals	Record Count	% of 7,159	Country	h-Index
1	<i>Journal of Ethnopharmacology</i>	522	7.292	Ireland	192
2	<i>Indian Journal of Traditional Knowledge</i>	238	3.324	India	33
3	<i>Industrial Crops and Products</i>	159	2.221	Netherlands	139
4	<i>Pharmaceutical Biology</i>	132	1.844	United Kingdom	64
5	<i>Pharmacognosy Magazine</i>	112	1.564	India	39
6	<i>PLOS One</i>	87	1.215	United States	332
7	<i>Biomedicine Pharmacotherapy</i>	76	1.062	France	92
8	<i>Natural Product Research</i>	76	1.062	United Kingdom	51
9	<i>3 Biotech</i>	74	1.034	Switzerland	37
10	<i>BMC Complementary and Alternative Medicine</i>	72	1.006	United Kingdom	0
11	<i>Indian Journal of Experimental Biology</i>	70	0.978	India	75
12	<i>Indian Journal of Pharmaceutical Sciences</i>	68	0.95	India	57
13	<i>Evidence Based Complementary and Alternative Medicine</i>	67	0.936	United States	90
14	<i>Parasitology Research</i>	67	0.936	Germany	94
15	<i>South African Journal of Botany</i>	65	0.908	Netherlands	59
16	<i>Phytotherapy Research</i>	64	0.894	United Kingdom	129
17	<i>Acta Physiologiae Plantarum</i>	63	0.88	Poland	71
18	<i>Current Science</i>	59	0.824	India	118
19	<i>Plant Cell Tissue and Organ Culture</i>	57	0.796	Netherlands	81
20	<i>Asian Pacific Journal of Tropical Medicine</i>	55	0.768	India	52
21	<i>Journal of Medicinal Plants Research</i>	54	0.754	Nigeria	57
22	<i>Scientific Reports</i>	51	0.712	United Kingdom	213
23	<i>Genetic Resources and Crop Evolution</i>	50	0.698	Netherlands	66
24	<i>National Academy Science Letters India</i>	50	0.698	India	19
25	<i>Phytomedicine</i>	48	0.67	Germany	120

Source: Based on WoS database.

Table 4. Document Type Publications on Ethnopharmacology Research During 2011 to 2021

S..No.	Document Types	Total Publications	% of 7,159
1	Articles	6,029	84.216
2	Review articles	1,019	14.234
3	Meeting abstracts	43	0.601
4	Editorial materials	40	0.559
5	Proceedings papers	32	0.447
6	Early access	29	0.405
7	Letters	19	0.265
8	Book chapters	8	0.112
9	Corrections	5	0.070
10	Retracted publications	5	0.070
11	News items	2	0.028
12	Book reviews	1	0.014
13	Publication with expression of concern	1	0.014
14	Retractions	1	0.014

Source: Based on WoS database.

Table 5. Collaboration Linkages Among Top 25 Organizations in Ethnopharmacology Research During 2011 to 2021

S. No.	Affiliations	Record Count	% of 7,159	TC	ACP	h-Index
1	Council of Scientific Industrial Research (CSIR) India	1039	14.513	17,821	17.15	52
2	Indian Council of Agricultural Research (ICAR)	348	4.861	3,906	11.22	30
3	Central Institute of Medicinal Aromatic Plants (CIMAP)	242	3.38	3,651	15.09	31
4	Indian Institute of Technology System (IIT System)	232	3.241	4,053	17.47	33
5	Academy of Scientific Innovative Research (ACSIR)	208	2.905	2,831	13.61	27
6	King Saud University	182	2.542	3,203	17.6	31
7	Banaras Hindu University (BHU)	178	2.486	2,792	15.69	31
8	Jamia Hamdard University	145	2.025	1,946	13.42	24
9	Department of Biotechnology (DBT) India	144	2.011	2,243	15.58	25
10	CSIR National Botanical Research Institute (NBRI)	139	1.942	2,641	19	27
11	CSIR Indian Institute of Integrative Medicine (IIIM)	135	1.886	2,449	18.14	28
12	Bharathiar University	125	1.746	2,778	22.22	29
13	CSIR Central Drug Research Institute (CDRI)	125	1.746	2,160	17.28	25
14	CSIR Institute of Himalayan Bioresource Technology (IHBT)	118	1.648	1,570	13.31	20
15	Indian Council of Medical Research (ICMR)	117	1.634	1,809	15.46	24
16	G B Pant National Institute of Himalayan Environment Sustainable Development (GBPNIHESD)	114	1.592	1,417	12.43	22
17	Defense Research Development Organization (DRDO)	110	1.537	1,773	16.12	24
18	University of Delhi	107	1.495	2,214	20.69	24
19	Jadavpur University	106	1.481	1,876	17.7	27
20	Aligarh Muslim University	102	1.425	1,787	17.52	23
21	Annamalai University	90	1.257	1,695	18.83	23
22	Vellore Institute of Technology	86	1.201	1,231	14.31	21
23	University of Kashmir	84	1.173	1,116	13.29	17
24	University of Mysore	84	1.173	1,025	12.2	16
25	Department of Science Technology India	83	1.159	1,221	14.71	20

Source: Based on WoS database.

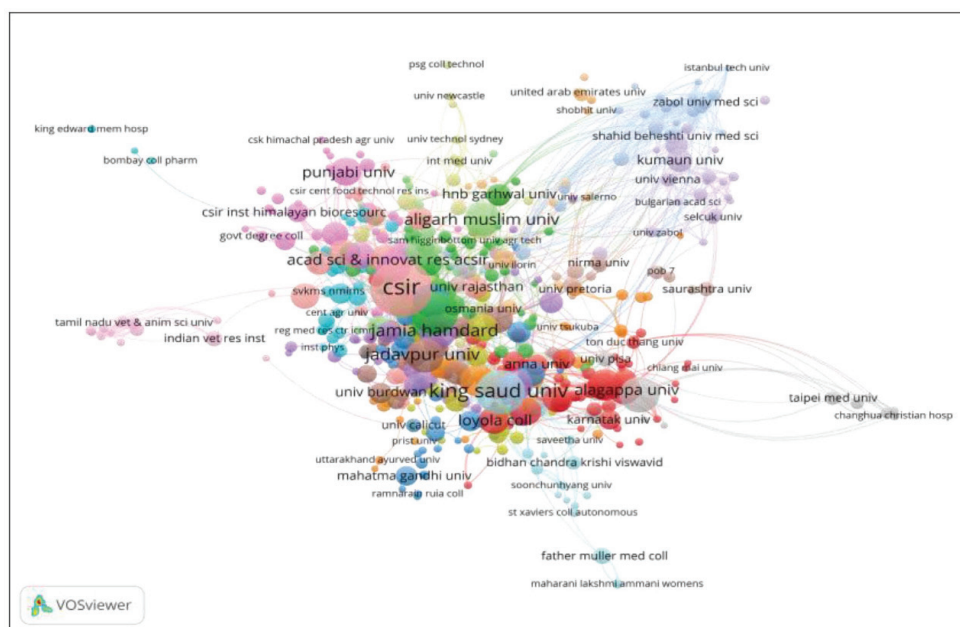


Figure 2. Top 25 Predictive Organizations.

Source: Based on WoS database.

Table 6. Scientometric Profile of Top Productive and Most Impactful Authors in Ethnopharmacology Research During 2011 to 2021.

S. No	Authors	Affiliation	Record Count	% of 7,159	TC	ACP	<i>h</i> -Index
1	Kumar Ashwani	University of Rajasthan	168	2.347	2,626	15.63	25
2	Kumar Sanjeet	Ambika Prasad Res Fdn	157	2.193	2,750	17.52	28
3	Singh Bishander	Veer Kunwar Singh University	112	1.564	1,363	12.17	20
4	Kumar Vipin	Central University of Rajasthan (CURAJ)	93	1.299	1,205	12.96	20
5	Sharma Anjali	Indian Council of Agricultural Research (ICAR)	81	1.131	1,134	14	16
6	Sharma S.	Guru Nanak Dev University	74	1.034	1,069	14.45	17
7	Kumar Rajesh	CSIR–Indian Institute of Toxicology Research (IITR)	73	1.02	819	11.22	18
8	Singh Amit	G B Pant National Institute of Himalayan Environment Sustainable Development (GBPNIHESD)	72	1.006	796	11.06	17
9	Singh Ram	Delhi Technological University	67	0.936	1,023	15.27	18
10	Kumar Deepak	CSIR–Indian Institute of Chemical Biology (IICB)	62	0.866	724	11.68	17
11	Sharma Prabha	University of Delhi	61	0.852	780	12.79	15
12	Kumar Puneet	Botanical Survey of India (BSI)	60	0.838	823	13.72	15
13	Singh Bikarma	CSIR–National Botanical Research Institute (NBRI)	60	0.838	1,075	17.92	16
14	Kumar Brijesh	Manav Rachna International Institute of Research and Studies	50	0.698	727	14.54	16
15	Ghosh Sampat	Andong National University	47	0.657	1,041	22.15	18
16	Gupta S	Chitkara University, Punjab	47	0.657	772	16.43	13
17	Ignacimuthu S	St Xaviers College	47	0.657	1,138	24.21	19
18	Sharma Vinit	Shoolini University	47	0.657	702	14.94	13
19	Singh Deeksha	Govt. Rajasthan	45	0.629	860	19.11	18
20	Singh, Mithilesh	GBPNIHESD	45	0.629	654	14.53	14
21	Sharma Neelam	Army Hosp Res and Referral	44	0.615	655	14.89	13
22	Bhatt Indra Dutt	GBPNIHESD	42	0.587	559	13.31	14
23	Singh Priya	Institute of Life Sciences India (ILS)	42	0.587	612	14.57	13
24	Mishra Shailja	Gurukul Kangri Vishwavidyalaya	41	0.573	798	19.46	14
25	Mishra Awanish	National Institute of Pharmaceutical Education and Research Guwahati	40	0.559	932	23.3	17

Source: Based on WoS database.

Source: Based on WoS database.

of *Ethnopharmacology* (192), *Industrial Crops and Products* (139), *Phytotherapy Research* (129). In terms of source country production, Indian journals were highest in the table with seven journals, followed by the United Kingdom with five journals, Netherland with four journals, and the United States and Germany have two journals each.

Form-Wise Research Output on Ethnopharmacology Research During 2011 to 2021

Table 4 shows the Indian ethnopharmacology research results that were published in various forms during 2011 to 2021. Of the total 7,159 publications, 6,029 (84.22%) of publications were published as journal articles, followed by review articles 1,019 (14.23%), and the remaining 2% of publications were scattered in other forms such as meeting abstracts, editorial materials, proceedings papers, early access, letters, book chapters, and so on.

Collaboration Linkages Among Top 25 Organizations in Ethnopharmacology Research During 2011 to 2021

India has contributed 7,159 papers in ethnopharmacology during 2011 to 2021. The top 25 Indian organization's scientometric profiles that are presented in Table 5.

On ranking Indian organizations by publication output, CSIR India tops with 1,039 papers, followed by ICAR India (348 papers), CIMAP (242 articles). In terms of *h*-index, CSIR India tops the list with *h*-index value of 52, followed by IIT (33), and CIMAP, King Saud University, and Banaras Hindu University (31 each). The most productive research organizations network map is shown in Figure 2. CSIR India, King Saud University, and Banaras Hindu University are the top three organizations with the most collaborative linkages. The other such organizations with the most minor collaborative links are—University of Kashmir, University of Mysore, Jadavpur University, Bharathiar University, and others. Research organizations from India such as CSIR India, Jamia Hamdard University, ICAR, and Banaras Hindu University were found to be the most productive institutions in collaborative research.

Scientometric Profile of Top Productive and Most Impactful Authors in Ethnopharmacology Research During 2011 to 2021

During 2011 to 2021, 16,658 authors contributed to ethnopharmacology research in India. Table 6 shows top 25 most productive authors. These 25 author's publications varied from 40 to 168 publications per author. Together these 25 authors contributed 1,677 (23.43%) publications share and 25,637 citations. Top three authors contributed 100 or more

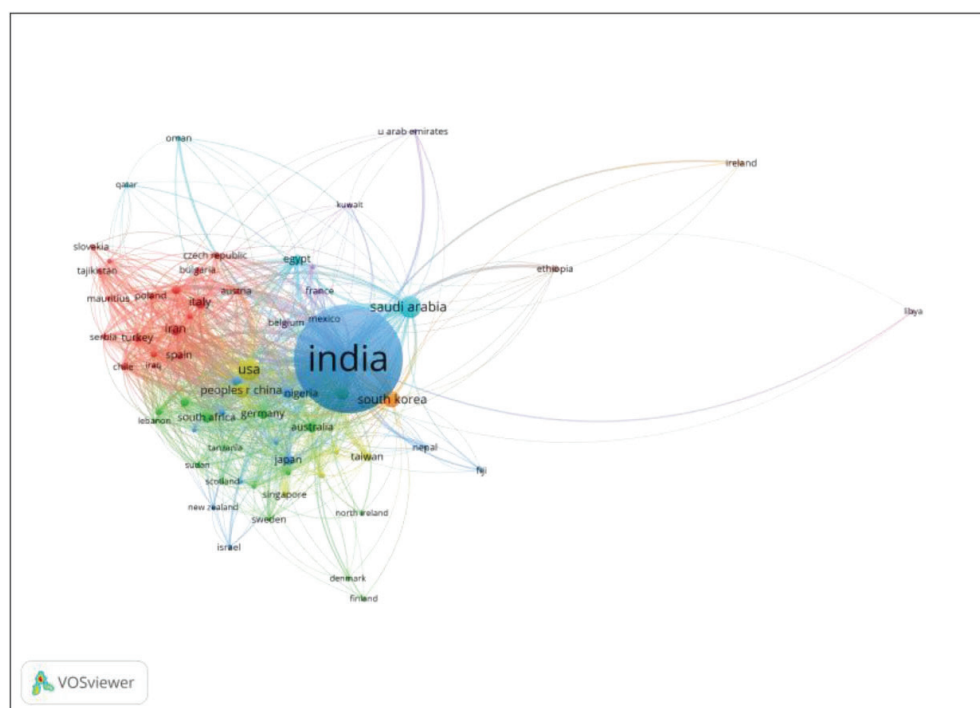


Figure 4. Collaborative Country Linkages.

Source: Based on WoS database.

papers; these are Ashwani Kumar (TP = 168; TC = 2626; *h*-index = 25), Sanjeet Kumar (TP = 157; TC = 2750; *h*-index = 28), and Bishander Singh (TP = 112; TC = 1363; *h*-index = 20). The author's collaboration visualization network is presented in Figure 3.

Top 25 Most Productive Countries

Table 7 and Figure 4 shows top 25 most productive countries in ethnopharmacology research. The United States of America is collaborated with 321 (4.484%) papers followed by Saudi Arabia (*n* = 298; 4.163%), and South Korea (*n* = 180; 2.514%). The top 10 most productive countries contributed 1,458 papers (20.36%). Figure 3 shows the countries' collaboration map. As India is a host country, it is in the middle of the graph and is collaborated with round the globe.

Table 8 shows the top 25 funding agencies for funding ethnopharmacology research in India during 2011 to 2021. Among the 25 funding agencies, 21 belong to India and 4 are international. The University Grants Commission (UGC) of

India sponsored 857 papers, followed by CSIR India (701) papers, Department of Science Technology (DST) India funded 586 papers, and Department of Biotechnology (DBT) India funded 406 papers. In terms of foreign funding agencies, National Institutes of Health (NIH), USA, funded for 32 papers, DSTD, Philippines, funded for 21 papers, and NSFC, China, funded for 13 papers.

Most Frequently Co-occurred Keywords

The keywords were analyzed as described in this section better to understand researchers' current concerns and future research directions. Article keywords can be considered as one of the most important pieces of background information reflecting the main goals of research paper. Therefore, this study collected and examined the keywords plus and keywords provided by the authors and the WoS database. The keywords received the broadest research interest and created subgroups according to different degrees of importance. Figure 5 shows the result of the keywords

Table 8. Top 25 Funding Agencies for Ethnopharmacology Research Publications During 2011 to 2020.

S. No.	Funding Agencies	Record Count	% of 7,159
1	University Grants Commission India	857	11.971
2	Council of Scientific Industrial Research (CSIR) India	701	9.792
3	Department of Science Technology India	586	8.186
4	Department of Biotechnology (DBT) India	406	5.671
5	Indian Council of Medical Research (ICMR)	260	3.632
6	King Saud University	76	1.062
7	Indian Council of Agricultural Research (ICAR)	53	0.74
8	Science Engineering Research Board Serb India	39	0.545
9	Defense Research Development Organization (DRDO)	36	0.503
10	United States Department of Health Human Services	33	0.461
11	National Institutes of Health USA	32	0.447
12	Ministry of Science and Technology Government of India	28	0.391
13	European Commission	27	0.377
14	Department of Atomic Energy (DAE)	26	0.363
15	Department of Biotechnology	23	0.321
16	Department of Science Technology Dost Philippines	21	0.293
17	Dst Purse	21	0.293
18	Board of Research in Nuclear Sciences (BRNS)	17	0.237
19	Entomology Research Institute	15	0.21
20	Portuguese Foundation for Science and Technology	14	0.196
21	National Natural Science Foundation of China (NSFC)	13	0.182
22	Department of Biotechnology Ministry of Science and Technology	12	0.168
23	Ministry of Human Resource Development, Government of India	12	0.168
24	University of Delhi	12	0.168
25	DST SERB	11	0.154

Source: Based on WoS database.

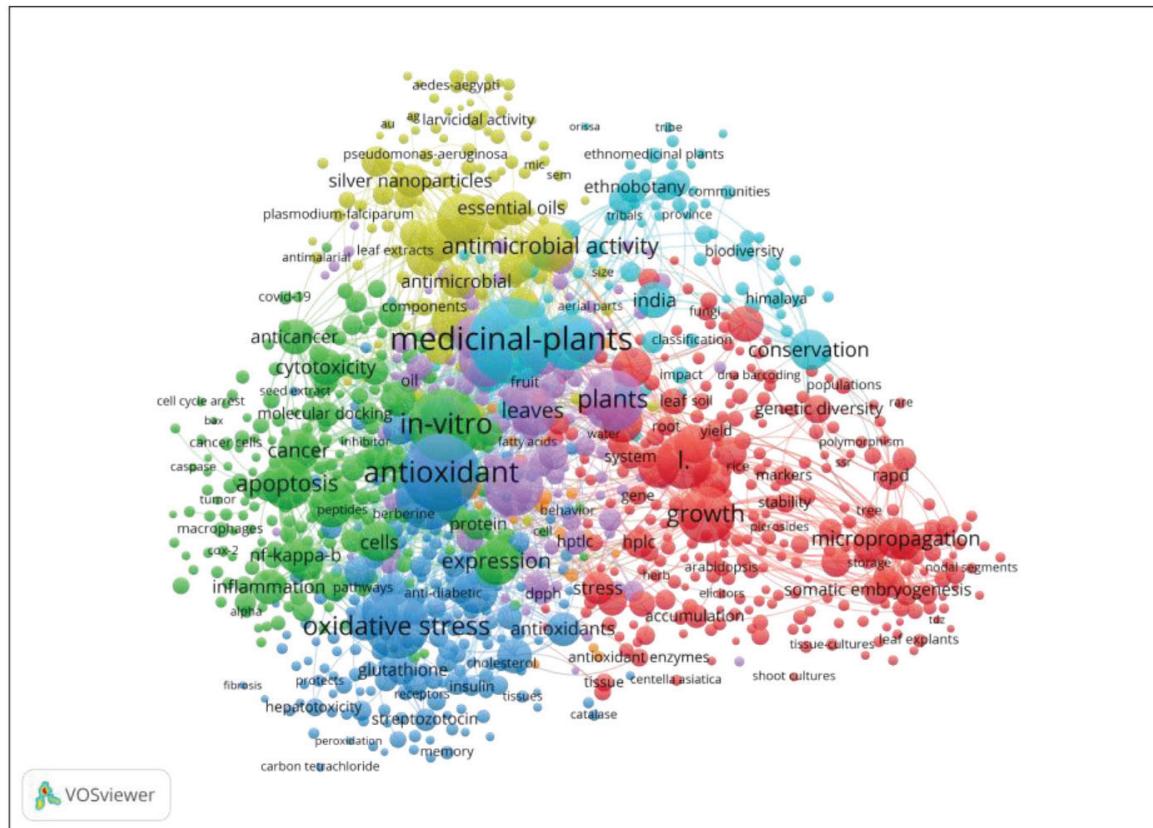


Figure 5. Most Frequently Co-occurred Keywords.

Source: Based on WoS database.

network map. Five main subgroups were formed. The circle size represents the density of the keyword and distances show the strength of the keywords. The essential keywords are medicinal plants, antioxidant, *in-vitro*, oxidative stress, antimicrobial activity, micropropagation, etc.

Summary

The WoS database yielded 7,159 publications with 109,035 citations and 15.23% average citations per paper publications during 2011 to 2020 on ethnopharmacology research. Results from research projects funded by 100+ funding agencies received 48,570 citations. The primary funding agencies supporting Indian research in this area are the UGC (857 papers) and the CSIR (701 papers). All publications published in English only accounted for the most prominent publications share (84.216%), followed by review articles (14.23%). The CSIR India collaborates with the ICAR and CSIR CIMAP in terms of domestic collaboration.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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