



INDIAN PERSPECTIVE OF MEDICINAL PLANT RESEARCH: A SCIENTOMETRIC STUDY

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ABSTRACT: The objective of this work was to analyse the scientometric parameters for Medicinal plant research publications. Investigators have compared the author productivity and citations by various institutions at national level. It could clearly see that during the period 1973-2009, a total of 1265 publications were published at national level and the data has reflected in Web of science database. This paper finds trend towards collaborative research is gaining momentum. As every work of researchers depends mainly on the library since it provides more scholarly information and hence this kind of studies are more relevant in identifying thrust areas of research.

Keywords: Scientometrics; Medicinal plant research; Citation Scores; Total Global Citation Scores; Total Local Citation Scores; h-index;

INTRODUCTION

Scientometrics is the branch of science that describes the output traits in terms of organizational research structure, resource inputs and outputs and develops benchmarks to evaluate the quality of information output [1]. Scientometrics characterizes, the disciplines using the growth pattern and other attributes. These studies have potential, particularly in assessing the emerging disciplines. In the present study, we did the scientometrics study of the research performance on medicinal plants, a significantly growing area in the knowledge-driven world.

Review of Literature

Stanhill, G. (2001)⁵ description of the growth of climate change science is presented based on the increase in the number of abstracts of scientific publications dealing with the many aspects of this broad subject. This number now totals 7000 and is doubling every 11 years. The annual rate of publication per author and number of authors per paper in climate change science, 1.75 and 2.5 respectively, were similar to those for scientific publications in general but, based on the U.S. data, the cost per publishing scientist is very high largely because of the sums allocated to satellite programs related to climate change research. The total global cost of current climate change research is estimated at three billion U.S. dollars annually. Two plausible but very different interpretations of the growth curve of climate change research are presented and used to discuss its future. The importance of extra-scientific factors in controlling the growth of climate change studies is emphasized, limiting the predictive value of the scientometric analysis presented. Garg, K.C. (2001) [6] analysed of 1223 papers published by India (347 papers) and China (876 papers) at conferences and as journal articles during 1993 and 1997 in the field of laser science and technology, indicates that China's output was twice to that of India. However, the activity index for both the countries in 1993 and 1997 were almost the same. Chinese scientists preferred to publish in domestic journals, while Indian scientists published in foreign journals. The number of papers by Indian scientists in SCI covered journals and journals with high normalized impact factor were more than China, and thus better connected to the mainstream science as compared to China. The impact made by Indian papers was more than Chinese papers as reflected by normalized impact per paper, proportion of high quality papers, and publication effective index. Indian papers also have more citations per paper than China. Mega authored papers by China were more than India.

OBJECTIVES OF THE STUDY

The main objectives framed for the purpose of the study are:

- To identify the rate of growth of scientific literature on Medicinal Plants in India
- To analyze the authorship pattern
- To assess the Institution wise research concentration in Medicinal Plant Research
- To apprehend and test the applicability of Lotka's law of author productivity
- To identify the Journal distribution of Medicinal Plant research output by Researchers.
- To test the Bradford's law of scattering in Medicinal Plant research output in Journals.

METHODOLOGY

The study entitled "Indian Perspective of Medicinal Plant Research: A Scientometric study" is a case study encompassing records output on Science from Science Citation Index (SCI) available online (Web of Science). The growth rate of output in terms of both at absolute level and relative level are analysed from 1973 to 2009. The authorship pattern and author productivity are examined to identify the pattern of research contribution in the field of Medicinal Plant. Further, an attempt is made to measure the performance of researchers and their research concentration in the field of medicinal plants. The study is mainly exploratory in nature in identifying research output on Medicinal Plant and it is also analytical in nature in strengthening the empirical validity due to application of suitable statistical calculations.

Analyses and Interpretation

Year wise Distribution of Medicinal Plants Research

Table 1 reveals that during the period 1973-2009, a total of 1265 publications were published at National level. The highest number of publication is 222 in 2008 with 211 Global Citation Scores followed by 215 papers in 2007 with 580 Global Citation Scores and 118 Local Citation Scores and 133 papers in 2009.

Ranking of Authors (Lotka's Law (Productivity of Authors))

Authors are ranked by number of publications. By clicking on the all-author hotlink, Investigators find the most-published author in Medicinal Plants (Table 2). Hotlinks also permit the display of the authors by Global or Local Citation Score. Thus the most-published ones are distinguished from the most-cited authors. The individual citation frequencies for these papers are totaled. Calculation of h-index is based on a list of publications ranked in descending order by the Times Cited. The value of h is equal to the number of papers (N) in the list that have N or more citations.

Document Type wise Distribution of Medicinal Plants Research

The highest number of publications were 997(78.8%) as journal article with 952 Local Citation Scores and 5286 Global Citation Scores and other publications were 105(8.3%) as Reviews, 70(5.5%) as conference proceedings, 54(4.3) as Note, 21(1.7%) as meeting Abstract, 10(0.8%) as Letter, 7(0.6%) as Editorial Materials, and other publication followed by other forms.

The research finds that the literature on medicinal plant research proliferated in 384 scholarly journals for the study period covered by Web of Science. The Journals of Ethno Pharmacology, Current Science and Indian journal of traditional knowledge were published major chunk of the research literature in medicinal plants among the journals. As 68.45 percent of the total literature for the study period has been published by top 5 journals, it is interpreted that the Bradford's law of scattering is correlating with this study. It is also found that the Journal of Ethno Pharmacology has got highest Total Global Citation Score and Local Citation score of 1310 and 210 respectively

Table 1 Year wise Distribution of Medicinal Plants Research

#	Year	Records	%	TLCS	TGCS	#	Year	Records	%	TLCS	TGCS
1	1973	1	0.1	1	7	20	1992	3	0.2	0	6
2	1974	6	0.5	4	28	21	1993	4	0.3	4	27
3	1975	8	0.6	4	44	22	1994	13	1.0	39	128
4	1976	5	0.4	8	43	23	1995	10	0.8	9	65
5	1977	4	0.3	11	47	24	1996	17	1.3	33	225
6	1978	7	0.6	10	57	25	1997	18	1.4	30	370
7	1979	8	0.6	9	66	26	1998	35	2.8	88	582
8	1980	6	0.5	10	66	27	1999	31	2.5	40	229
9	1981	10	0.8	12	71	28	2000	36	2.8	87	636
10	1982	12	0.9	15	107	29	2001	37	2.9	57	400
11	1983	9	0.7	14	93	30	2002	44	3.5	89	556
12	1984	10	0.8	15	86	31	2003	49	3.9	69	551
13	1985	5	0.4	8	46	32	2004	72	5.7	79	515
14	1986	4	0.3	0	17	33	2005	97	7.7	90	509
15	1987	7	0.6	8	26	34	2006	89	7.0	83	461
16	1988	13	1.0	17	124	35	2007	215	17.0	118	580
17	1989	6	0.5	8	45	36	2008	222	17.5	38	211
18	1990	5	0.4	2	21	37	2009	133	10.5	2	12
19	1991	14	1.1	20	113						

Institution wise distribution of Medicinal Plants Research

Table 5 indicates Institution-wise research productivity. It is noted that Central Institute of Medicinal & Aromatic Plants ranks first in order by contributing 33(2.6%) of total research output of 1265. Indian Institute of Chemical Biology records the second place in order and Indian Institute Experimental Medicine, which shares third position with followed by 25(2.0%), CSIR 24(1.9%), Bharathidasan University has contributed 6 papers. The publications of other Institutions are as follows:

Table 2 Authorship Pattern of Medicinal Plants Research

#	Author	Records	h-index	TLCS	TGCS
1	Pakrashi Sc	47	13	72	433
2	Kumar S	23	6	12	94
3	Achari B	22	10	37	249
4	Kumar A	21	3	4	25
5	Ali E	18	8	28	160
6	Jaleel CA	18	11	98	273
7	Chakravarty Ak	17	10	34	174
8	Panneerselvam R	17	11	95	270
9	Singh S	14	3	5	82
10	Ali M	13	7	24	100
11	Bhutani KK	13	8	24	118
12	Khanuja SPS	13	3	3	49
13	Singh A	13	4	2	46
14	Ignacimuthu S	12	5	16	82
15	Kumar V	12	4	5	65
16	Rout GR	12	4	17	80
17	Seeni S	12	6	44	116
18	Gopi R	11	8	68	186
19	Pushpangadan P	11	6	25	93
20	Anis M	10	3	5	24

Results found: 1,265
Sum of the Times Cited: 7,170
Average Citations per Item: 5.67
h-index : 31

Table 3 Document Type wise Distribution of Medicinal Plants Research

#	Document Type	Records	%	Total LCS	Total GCS
1	Articles	997	78.8	952	5286
2	Reviews	105	8.3	91	1370
3	Proceeding Paper	70	5.5	19	108
4	Note	54	4.3	62	357
5	Meeting Abstracts	21	1.7	0	0
6	Letters	10	0.8	2	3
7	Editorial Material	7	0.6	5	46
8	Book Review	1	0.1	0	0

Table 4. Journal wise Distribution of Medicinal Plants Research (Journals: 384)

. #	Journal	Publisher	Records	TLCS	TGCS
1	Journal of Ethnopharmacology	Elsevier Science	80	232	1310
2	Current Science	Indian Academy of Sciences	64	65	346
3	Indian Journal of Traditional Knowledge	NISCAIR	55	1	1
4	In Vitro Cellular & Developmental Biology-Plant	Springerlink	30	28	135
5	Plant Archives	Plant Archives	30	0	1
6	Phytochemistry	Elsevier Science	29	57	575
7	Pharmaceutical Biology	Taylor and Francis	26	15	43
8	Phytotherapy Research	Wiley	26	31	223
9	Indian Journal of Chemistry Section B-Organic Chemistry Including Medicinal Chemistry	NISCAIR	25	16	137

10	Fitoterapia	Elsevier Sciece	21	25	62
11	African Journal of Biotechnology	Academic Journals	20	2	15
12	Asian Journal of Chemistry	UBS Publishers	19	1	4
13	Plant Cell Tissue and Organ Culture	Springerlink	18	61	203
14	Biologia Plantarum	Springerlink	15	12	62
15	National Academy Science Letters-India	National Academy of Science	15	0	6
16	Indian Journal of Experimental Biology	NISCAIR	14	1	36
17	Journal of Plant Biochemistry And Biotechnology	Indian Agriculture Institute	14	8	18
18	Plant Cell Reports	Springerlink	14	54	154
19	Journal of the Indian Chemical Society	Indian Chemical Society	12	4	53
20	Indian Journal Of Medical Research	ICMR	11	13	86

Table 5 shows Institution wise distribution of Medicinal Plants Research (Top 30)

#	Institution	Records	TLCS	TGCS
1	Central Institute of Medicinal & Aromatic Plants	33	23	185
2	Indian Institute of Chemical Biology	25	28	274
3	Indian Institute Experimental Medicine	25	46	244
4	CSIR	24	31	180
5	Central Drug Research Institute	23	21	186
6	GB Pant Institute of Himalayan Environment & Development	22	72	218
7	National Botanical Research Institute	22	35	160
8	Bhabha Atom Research Centre	21	20	146
9	University Delhi	21	12	199
10	Aligarh Muslim University	19	60	229
11	Banaras Hindu University	19	28	428

12	Annamalai University	18	85	263
13	University Calcutta	18	26	127
14	Tropical Botanical Garden & Research Institute	17	53	156
15	University Madras	16	12	87
16	Indian Institute Technology	13	4	64
17	Jawaharlal Nehru University	13	25	111
18	Hamdard University	11	5	55
19	Regional Research Laboratory	11	13	62
20	Indian Toxicology Research Centre	10	16	87

Collaboration of Medicinal Plants Research with other countries

Table 6 indicates that 44 articles contributed in collaboration with United States of America, which is followed by United Kingdom(10), South Korea(8) Italy(6), and Denmark, France and Germany with 5 research articles. Indian Researchers have collaborated with more than 36 countries in the area of research in Medicinal Plant.

Table 6. Country wise Collaboration of Medicinal Plants Research

#	Country	Records	TLCS	TGCS	#	Country	Records	TLCS	TGCS
1	India	1257	1124	6897	19	Austria	1	0	7
2	USA	44	30	312	20	Cote Ivoire	1	1	5
3	UK	10	8	209	21	Ethiopia	1	0	0
4	South Korea	8	1	31	22	Kenya	1	1	5
5	Italy	6	0	5	23	Luxembourg	1	0	2
6	Denmark	5	9	261	24	Malawi	1	1	61
7	France	5	7	46	25	Malaysia	1	0	0
8	Germany	5	3	264	26	New Zealand	1	0	0
9	Peoples R China	4	3	27	27	Norway	1	1	4
10	Canada	3	0	22	28	Pakistan	1	0	1
11	Israel	3	3	17	29	Poland	1	0	1

12	Japan	3	5	29	30	Saudi Arabia	1	0	1
13	Belgium	2	2	9	31	South Africa	1	0	0
14	Brazil	2	1	161	32	Sri Lanka	1	0	1
15	Mexico	2	0	1	33	Syria	1	0	1
16	Sikkim	2	0	0	34	Taiwan	1	0	0
17	Singapore	2	0	9	35	Tanzania	1	0	0
18	U Arab Emirates	2	0	2	36	Uruguay	1	10	38

Subject wise Distribution of Medicinal Plant Research
Table 7. Subject wise Distribution of Medicinal Plant Research

#	Subject Area	Records	%
1	Plant Sciences	425	33.60
2	Pharmacology & Pharmacy	260	20.55
3	Chemistry, Medicinal	203	16.05
4	Biotechnology & Applied Microbiology	115	9.09
5	Biochemistry & Molecular Biology	100	7.91
6	Integrative & Complementary Medicine	98	7.75
7	Multidisciplinary Sciences	86	6.80
8	Environmental Sciences	56	4.43
9	Agronomy	54	4.27
10	Chemistry, Organic	52	4.11
11	Horticulture	51	4.03
12	Cell biology	48	3.79
13	Chemistry, multidisciplinary	48	3.79
14	Biology	38	3.00
15	Food science & technology	38	3.00
16	Ecology	33	2.61
17	Toxicology	33	2.61
18	Developmental biology	32	2.53
19	Medical laboratory technology	30	2.37
	Others subjects Less than 30 Publications		

It evident from table 7 that most of the articles 425(33.60%) covered in Plant sciences, which is followed by Pharmacology & Pharmacy with 260(20.55%), Chemistry, Medicinal with 203(16.05%), Biotechnology & Applied Microbiology with 115(9.09%), Biochemistry & Molecular Biology with 100(7.91%) publications respectively and others subject disciplines having less than 100 Publications.

FINDINGS AND CONCLUSION

The research has been undertaken to assess the research productivity of researchers on Medicinal Plant Literatures. The findings of the study lead to the following observations:

- The findings of the year wise distribution of research output on Medicinal Plant bring out the fact that the highest publication is 222 in the year 2008 with 211 Global Citation Scores, there is consistent growth in terms of research publications from 1994 to 2008, while fluctuation found for the period 1973 to 1993. The average citation per article is 5.67 and the H index of the medicinal plants research is 31.
- The finding of the ranking of authors based on their publications brings out the fact that Pakrashi SC captured the first place with 47 Publications with 72 Local Citation Scores and 433 Global Citation Scores and the h-index is of the author is 13. Authors with minimal number of publications were scored higher citations. Thus the most-published ones are distinguished from the most-cited authors. Authorship pattern is collaborative in nature.
- As the top 20 authors contributed more than 25 percent of the total publications among 2813 authors, the applicability of Lotka's law tested is positive.
- A large number of research institutions (700 and above) have contributed the medicinal plants research in India, while the top 20 institutions contribute 30 percent of the total research output for the study period.
- The finding of the source wise distribution of research output brings out the fact that the journal articles occupied the predominant place among the other sources of publications.
- The finding of the ranking of journals brings out the fact that the highest number of publications were 80(6.3%) published in Journal of Ethnopharmacology. As the top 20 Journals (5.2%) contribute 48 percent of the total literature (538 articles) among the 384 journals, it proves the applicability of Bradford's law of scattering.

It is to conclude that the sum of citations of the medicinal plants research publications and the h index scored is good. Since, the database found contributions only from 1973, that the research begins during the period.

REFERENCES

- [1] K. V. Krishnamurthy (2007), "Scientometrics", Bharathidasan University Journal of Science and Technology, Vol. 1 No. 2, PP. 162-168.
- [2] Surulinathi, M et al. (2008), "Scientometric Dimensions of Knowledge Management Research in India: A Study based on Scopus database", Sri Lankan Journal of Librarianship and Information Management, Vol. 2 No. 2, PP. 13-24.
- [3] Thanuskodi, S and Venkatalakshmi, V (2009), "The Growth and Development of Research output on ecology in India: A Bibliometric Study", Indian Journal of Information Science and Services, Vol. 3 No. 1, PP. 41-48
- [4] Kademani, B.S., Kalyane, V.L. and Kumar, V. (2001), "Scientometric portrait of Nobel laureate Ahmed Hassan Zewail", Malaysian Journal of Library & Information Science, Vol. 6, No. 2, pp. 53-70.
- [5] Stanhill, G. (2001). "The growth of climate change science: a scientometric study", Climatic Change, Vol. 48, No. 2-3, pp. 515-524.
- [6] Garg, K.C. (2001), "Scientometrics of laser research in India and China", 8th International Conference on Scientometrics and Informetrics. Proceedings - ISSI-2001, Vol. 1, Pt. 1, pp. 167-177.