Asian Journal of Information Science and Technology
ISSN: 2231-6108 Vol.9 No.3, 2019, pp. 25-30

A Scientometric Analysis of Indian Research Output in Marine Drugs during 1989-2017

V. Jayasree[1] and M. D. Baby[2]
[1]Research Scholar, Bharathiar University, Coimbatore, Tamil Nadu, India
[2] Professor & Head, School of Library & Information Science, Rajagiri College of Social Science, Kerala, India
E-Mail: jayasreernair@gmail.com, dr.babyjohny@gmail.com

Abstract **- The study analyzes the Marine drugs research output from the year 1989-2017. The data was downloaded from the Web of Science maintained by Thomson Reuters. The findings of the study revealed that the highest number of TLCS and TGCS witnessed in the year 2010 i.e. 1131 (9.63%) and 10381 (7.29%). The study shows that a major source of publication in Marine Drugs research comes in the form of articles and India with 416 records ranked the third position among the country-wise distribution of records.**
Keywords: **Scientometrics, Marine Drugs, India**

I. INTRODUCTION

Disease ailments are changing the patterns, and new diseases are emerging due to changing environments. The enormous growth of world population has overburdened the existing resources for the drugs. Marine biosphere is the largest one of the earth and harbours an enormous number of different organisms. Marine environment represents a countless and diverse resource for new drugs to combat major diseases. Drugs from the sea are one of the most promising new directions of marine science. Marine-derived drugs are pharmacologically active substances isolated from the marine organism and developed into suitable forms for human use. Marine drugs have given hope as novel mechanisms to fight some of the most debilitating diseases of man such as HIV, Osteoporosis, Alzheimer's disease, and Cancer.

India has over 8000 km of coastline with clusters of marine habitats like inter-tidal rocky, muddy and sandy shores, coral reefs and mangrove forests. The potential of Indian marine habitat has remained largely unexplored for their potential of new drugs and biotechnological programs. Some of the selected institutes such as National Institute of Oceanology, Goa; Central drug research institute, Lucknow, Bose Institute, Kolkata; Central Institute of Fisheries Education, Mumbai; Regional Research Laboratory, Bhubaneswar & Council of Scientific and Industrial Research are presently working for exploration of life saving drugs from marine sources apart from many other institutes, universities and pharmaceutical companies.

The evolution of marine pharmacology as a specialty of India will help us optimize the use of rich marine resources around our beautiful country gifted with a vast coastline.

Scientometrics is defined as the application of quantitative methods which deals with the analysis of science viewed as an information process. As a technique, it has extensive applications in understanding the structure of a discipline, identifying the research trends and research networks, growth of knowledge, calculating the research impact of a published work,, trends in authorship and collaboration in research, identify suitable research partners in one's own specialized research field, potential for cross-disciplinary work, and potential for national and international collaboration. It is interdisciplinary typically used to measure scientific publications indexed in databases. Quantification is imperative in all aspects of life. The academic and research activities need to be measured even in the scholarly world. Scientometrics has become a leading tool for measuring the value of research activities, evaluation of research output by an individual, or a group of scientists, a nation or a group of nations is important for identifying scientific priorities and corresponding policy decisions/modifications for the development of science and technology.

Gupta and Dhawan (2019) in their article Parallel computing research in India: A scientometric assessment of Indian publications output during 1998-2017 published in COLLNET Journal of Scientometrics and Information Management has examined research output of India in parallel computing, as indexed in Scopus database on a series of bibliometric measures, such as publications growth rate, global publications share, citation impact, national-level share of international collaborative papers, distribution of publications by broad subjects. The study discusses the citation profile of top organizations and authors from India in parallel computing, and the preferred media for research communication, and characteristics of highly cited papers. The study finds that India registered 23.32% growth rate, contributed 3.70% global publications share, published 14.73% share of its output as international collaborative publications, and averaged citation impact of 5.15 citations per paper in the subject during the period. Hardware research is most popular sub-area of research in parallel computing. India contributed 26.03% share of output in parallel computing in top 15 most productive journals, and 14 of its papers have been rated as highly cited papers each with 82 to 663 citations per paper. Singh et al (2019) in their study titled Research dynamics in Indian fisheries and

aquaculture: a scientometric analysis published in Current science mapped out the dynamics of scientific output in fisheries and aquaculture in India during the decade 2007–2016, applying scientometric tools. The data was retrieved from 'Scopus' database for phrases such as 'fisheries', 'fishery' and 'aquaculture' as main operators. The search results were filtered for journal articles, English language and for the period 1 January 2007–31 December 2016. The study revealed that the number of articles on fisheries and aquaculture has more than doubled from 2007 to 2016. The results indicated a significant correlation between the number of citations and the number of years from which the article has been published. The United States emerged to be the topmost collaborator of India to work in this field followed by South Korea, the United Kingdom, Japan, and Germany. The network visualization is expected to be useful to the scientific community in analyzing the research trends in the subject under study and further strengthening the research activities.

Dwivedi, *et al.,* (2015) published their paper on "Scientometric Profile of Organic Chemistry Research in India During 2004–2013" in 'Current Science'. An analysis of 17,344 papers published by Indian scientists and indexed by Web of Science in the discipline of organic chemistry and its sub-disciplines during 2004–2013 indicates that the Indian output has increased significantly in the later period. Academic institutions contributed about 46% of the total output followed by the Council of Scientific and Industrial Research (CSIR) with 26% of the total output. The most prolific institutions among them mainly belonging to academic institutions and CSIR contributed about 60% of the total output. The value of citation per paper for most of the prolific institutions was higher than the Indian average. A similar trend was observed for the relative citation impact. Indian researchers in the discipline of organic chemistry published their papers in international journals with an impact factor greater than 1. About 11% of the papers published by Indian scientists in the discipline of organic chemistry during 2004–2013 remained uncited.

Gupta and Gupta (2014) published "Prostate Cancer Research in India: A Scientometric Analysis of Publications Output during 2014-13" in 'International Journal of Cancer Therapy and Oncology'. The authors examined 1,368 publications on prostate cancer in India, as covered in Scopus database during2004-13, experiencing an annual average growth rate of 18.77% and citation impact of 5.23. The world prostate cancer output (89,994 publications) came from several countries, of which the top 15 (United States, United Kingdom, Germany, Canada, Italy, Japan, and China) accounts for 94.80% share of the global output during 2004-13. India's global publication share was 1.52% and hold 14th rank in global publication output during 2004-13. The Indian prostate cancer output came from several organizations and authors, of which the top 20 and 19 contributed 41.81% and 24.05% share, respectively, during 2004-13. India's international collaborative share in prostate cancer was 23.39%, which decreased from 24.42% to 22.98% from 2004-08 to 2009-13. Medicine accounted for the largest share (59.50%) of output in prostate cancer followed by biochemistry, genetics and molecular biology (40.13%), pharmacology, toxicology &pharmaceutics (27.63%), chemistry (8.55%), agricultural and biological sciences (4.31% share), and immunology and microbiology (2.70% share) during 2004-13. Diagnosis, screening, chemotherapy, radiotherapy, pathology, and prognosis together account for 60.24% publications share among treatments methods used in Indian prostate cancer research during 2004-13. Only Delhi, Maharashtra, Uttar Pradesh, and Tamil Nadu together contributed 57.82% share in Indian publications output in prostate cancer during 2004-13. The authors stressed the need for developing a national policy for prostate cancer which should take care of screening for detection and diagnosis, management and treatment options of the prostate cancer patients in India.

Sagar, *et al.,* (2014) conducted a study entitled "Agriculture Research in India: A Scientometric Mapping of Publications" in 'DESIDOC Journal of Library & Information Technology'. The study analyzes the agriculture research publications in India during 1993-2012 based on the Web of Science database. The objective of the study was to perform a scientometric analysis of all agriculture research publications by Indian scientists. The parameters studied include growth of publications and citations, domain-wise distribution of publications and citations, activity index, international collaboration, highly productive institutions, highly preferred journals, and highly cited publications.

II. OBJECTIVES OF THE STUDY

To analyze the Indian research productivity in the field of marine drugs is the main objective of the study. The specific objectives are to

1. Analyze year-wise Indian research output in marine drugs.
2. Assess the global publication share in marine drugs.
3. To find out the most prolific authors researching marine drugs.
4. Study the contribution of top journals in marine drugs
5. To find out the top areas of research.
6. To find out the language-wise distribution of papers.
7. To find the collaboration pattern of authors.

III. METHODOLOGY

The data required for the present study was obtained from the Web of Science database which an online subscription-based scientific citation is indexing service originally produced by the Institute for Scientific Information, later maintained by Clarivate Analytics. It is one of the world's leading citation databases, with multidisciplinary information from over 18,000 high impact journals. Web of Science database was searched to obtain the research volume data in the field of marine drugs from January 1, 1989, to December 31, 2017. The prime keywords used for

the search and download were marine drugs and marine medicine. There were 4637 records found in the drugs and marine medicine, which are being analyzed and displayed in the respective tables.

IV. ANALYSIS AND INTERPRETATION

A. Year-Wise Growth of Articles

TABLE I YEAR-WISE GROWTH OF ARTICLES

S. No.	Publication Year	Records	Percent	TLCS	%	TGCS	%
1	2017	508	11.0	28	0.24	2561	1.80
2	2016	464	10.0	128	1.09	4573	3.01
3	2015	427	9.2	291	2.48	6315	4.43
4	2014	421	9.1	555	4.73	7914	5.55
5	2012	343	7.4	733	6.24	8935	6.27
6	2013	340	7.3	571	4.86	7786	5.46
7	2011	288	6.2	693	5.90	8677	6.09
8	2010	256	5.5	1131	9.63	10381	7.29
9	2009	234	5.0	1067	9.09	9177	6.44
10	2008	190	4.1	729	6.21	9457	6.64
11	2007	154	3.3	705	6.00	7959	5.59
12	2006	143	3.1	817	6.96	9914	6.96
13	2005	123	2.7	745	6.34	6794	4.77
14	2004	110	2.4	695	5.92	6913	6.96
15	2003	101	2.2	566	4.82	6225	4.37
16	2002	74	1.6	354	3.01	3863	2.71
17	2001	73	1.6	603	5.13	6189	4.34
18	1999	58	1.3	152	1.29	2729	1.92
19	2000	52	1.1	308	2.62	3890	2.73
20	1998	48	1.0	161	1.37	2593	1.82
21	1995	43	0.9	120	1.02	2263	1.59
22	1994	40	0.9	86	0.73	1650	1.16
23	1996	36	0.8	104	0.89	1122	0.79
24	1997	33	0.7	109	0.93	1239	0.87
25	1992	32	0.7	109	0.93	1371	0.96
26	1993	25	0.5	112	0.95	1386	0.97
27	1991	20	0.4	72	0.61	618	0.43
28	1989	1	0.0	0	0	0	0
		4637	100	11,744	100	1,42,494	100

(TLCS) Total local citation score, (TGCS) Total global citation score

A total of 4637 publications on marine drugs were published during 1989 to 2017 which has received 11,744 Total Local Citation Score (TLCS) and 1,42,494 Total Global Citation Score (TGLS). In the year-wise distribution of articles, year 1989 has only one record and consistent growth found from 1989 to 2017.

Year 2017 witnessed highest number of records with 508 (11.0%) followed by 2016 with 464 (10.0%), 2015 with 427 (9.2%), 2014 with 421 (9.1%). Major growth witnessed from 2014 -2017. Highest number of TLCS and TGCS witnessed in the year 2010 i.e. 1131 (9.63%) and 10381 (7.29%), Average number of articles published per year was 165.6 and global citation was 5089.07.

B. Document Types

Distribution of document-wise analysis is done in the Web of Science and found 16 different documents. Among these documents, articles with 3355 (72.4%) stood the first position, other items found in the database were review 993 (21.4%), Articles: proceedings paper 162 (3.5%), and meeting abstract 50 (1.1). Other items such as editorial material, review: book chapter, correction, news item, etc occupied 1.6%

TABLE II DOCUMENT TYPES

S. No.	Document Type	Records	Percent	TLCS	TGCS
1	Article	3355	72.4	6892	81900
2	Review	993	21.4	4248	52373
3	Article; Proceedings Paper	162	3.5	442	7224
4	Meeting Abstract	50	1.1	6	16
5	Editorial Material	34	0.7	52	324
6	Review; Book Chapter	13	0.3	22	216
7	Correction	6	0.1	1	10
8	News Item	5	0.1	25	67
9	Article; Book Chapter	4	0.1	0	76
10	Chronology	3	0.1	0	9
11	Letter	3	0.1	3	12
12	Note	3	0.1	33	148
13	Article; Retracted Publication	2	0.0	0	22
14	Review; Retracted Publication	2	0.0	20	97
15	Book Review	1	0.0	0	0
16	Reprint	1	0.0	0	0

C. Author-Wise Distribution

TABLE III AUTHOR-WISE DISTRIBUTION

S. No.	Author	Records	TLCS	TGCS
1	Gerwick WH	46	520	2403
2	Jimeno J	38	514	2402
3	D'Incalci M	36	504	2385
4	Kim SK	33	210	1367
5	Fenical W	31	457	2774
6	Hamann MT	31	310	2827
7	Li J	29	54	491
8	Cuevas C	24	247	1123
9	Pettit GR	24	176	1300
10	Jensen PR	23	421	2445

(TLCS) Total local citation score, (TGCS) Total global citation score

Among author-wise distribution, Gerwick WH published 46 records stood the first position followed by Jimeno J, D'Incalci M, and Kim SK published 38, 36, 33 articles ranked second, third and fourth respectively and Fenical W and Hamann both published 31 records each ranked fifth. Indian authors have not been seen in the top 10 ranked authors and it was also witnessed that they were not seen in the top 10 Global Cited Score also.

D. Authorship Pattern

It is found that 5619 total authors have contributed articles on marine drugs from 1989 to 2017. Out of 5619 authors, only 365 publications have single authors and remaining publications were made by more than one author. Among authorship collaboration, it is found that six authors have published the highest number of publications followed by three, four and five authors.

TABLE IV AUTHORSHIP PATTERN

Authorship Pattern	No of Authors	%
Single Authors	365	6.50
Double	556	9.89
Three	670	11.92
Four	606	10.78
Five	588	10.46
Six	1473	26.21
Seven	379	6.74
Eight	291	5.18
Nine	195	3.47
Ten and above	496	8.83
Total	5619	100

E. Top Ranked Journals

Top 20 journals publication with percentage and citation is listed. Among the top 20 journals, 325 (7.0%) papers have been published in Marine Drugs journal followed by Journal of Natural Products, Plos One Bioorganic & Medicinal Chemistry, Bioorganic Medicinal Chemistry Letters, Molecules, Current Medicinal Chemistry, Aquaculture, Plant Medicine, and Journal of Medicinal Chemistry secured top ten ranks. The total local citation score (TLCS) and the total global citation score (TGCS) were also calculated. TLCS is the number of times a set of papers included in a collection that has been cited by other papers within the collection. TGCS is the number of times a set of papers included in a collection has been cited in the WoS. TLCS and TGCS have been the key indicators capable of evaluating the relevance of each research paper. Meanwhile, an approach considering the average citation per year was

also used (TLCS/t and TGCS/t). TLCS/t is the total local citation score per year from the time the research papers' publication to the end of the sample period, and TGCS/t is the total global citation score per year from the research papers' publication to the end of the sample period.

TABLE V TOP RANKED JOURNALS

S. No.	Journal	Records	Percent	TLCS	TLCS/t	TGCS	TGCS/t	TLCR
1	Marine Drugs	325	7.0	1034	189.54	7749	1829.91	1690
2	Journal of Natural Products	95	2.0	628	65.99	3801	505.02	261
3	Plos One	70	1.5	0	0.00	1144	254.19	155
4	Bioorganic & Medicinal Chemistry	55	1.2	229	26.15	1907	233.79	95
5	Bioorganic & Medicinal Chemistry Letters	49	1.1	99	14.32	983	135.46	68
6	Molecules	43	0.9	103	16.89	1520	379.48	286
7	Current Medicinal Chemistry	42	0.9	220	19.14	2286	204.54	181
8	Aquaculture	41	0.9	79	5.55	1845	158.89	48
9	Planta Medica	38	0.8	77	12.41	646	113.47	117
10	Journal of Medicinal Chemistry	34	0.7	134	13.90	1526	174.60	51
11	Proceedings of the National Academy of Sciences of The United States of America	34	0.7	378	34.25	3827	480.85	61
12	European Journal of Medicinal Chemistry	33	0.7	38	8.09	1167	325.85	107
13	Frontiers in Microbiology	32	0.7	0	0.00	389	202.92	163
14	Science of the Total Environment	32	0.7	61	13.86	1999	355.71	65
15	Biochemical Pharmacology	31	0.7	201	19.67	1172	117.70	85
16	Applied Microbiology and Biotechnology	28	0.6	175	20.81	1186	165.81	153
17	Military Medicine	28	0.6	2	0.14	180	17.14	2
18	Cancer Research	26	0.6	326	23.51	2584	192.05	58
19	Marine Biotechnology	25	0.5	111	9.68	801	85.03	72
20	Tetrahedron Letters	25	0.5	34	3.91	402	55.00	31

(TLCS) Total local citation score, (TGCS) Total global citation score

F. Language-Wise Distribution of Publication of Articles

TABLE VI LANGUAGE-WISE DISTRIBUTION OF PUBLICATION OF ARTICLES

S. No.	Language	Records	TLCS	TGCS
1	English	4545	11728	142062
2	Chinese	22	3	117
3	Japanese	20	7	80
4	Spanish	14	2	52
5	Portuguese	11	3	119
6	French	9	1	38
7	German	6	0	22
8	Russian	5	0	4
9	Turkish	2	0	0
10	Croatian	1	0	0
11	Czech	1	0	0
12	Polish	1	0	0

In the language-wise distribution of records, English is the predominant language which has highest records of 4545 followed by Chinese with 22 records, Japanese with 20 records, Spanish with 14, Portuguese with 11, French with 9, German with 6, Russian with 5, Turkish with 2 and Croatian, Czech and Polish each with one record.

G. Country-Wise Distribution

TABLE VII COUNTRY WISE DISTRIBUTION

S. No.	Country	Recs	TLCS	TGCS
1	USA	1163	4942	50792
2	Peoples R China	538	723	10146
3	India	416	509	8593
4	Japan	284	806	8349
5	Italy	280	829	8115
6	Spain	276	871	8102
7	Germany	265	757	10440
8	UK	237	719	10432
9	Australia	232	620	9326
10	France	205	491	9646

(TLCS) Total local citation score, (TGCS) Total global citation score

Among country-wise distribution of records, USA ranked with the first position by publishing 1163 records with 25.1% followed by Peoples R China with 538 records, India with 416 records ranked third position and other countries

such as Japan, Italy, Spain, Germany, UK, Australia, and France in the top 10 ranks.

H. Research-Area

TABLE VIII RESEARCH AREA

Research Areas	Records	%
Pharmacology Pharmacy	1542	33.233
Chemistry	837	18.039
Biochemistry Molecular Biology	654	14.095
Biotechnology Applied Microbiology	337	7.263
Oncology	323	6.961
Environmental Sciences Ecology	273	5.884
Microbiology	267	5.754
Marine Freshwater Biology	261	5.625
Plant Sciences	239	5.151
Science Technology Other Topics	234	5.043
Toxicology	228	4.914
Food Science Technology	119	2.565
Fisheries	110	2.371
Integrative Complementary Medicine	92	1.983
Engineering	90	1.940
Research Experimental Medicine	90	1.940
Cell Biology	89	1.918
Public Environmental Occupational Health	79	1.703
General Internal Medicine	78	1.681
Veterinary Sciences	74	1.595
Materials Science	68	1.466
Oceanography	67	1.444
Immunology	63	1.358
Biophysics	61	1.315
Endocrinology Metabolism	57	1.228

Analysis based on research area shows that 1633 (33.23%) records were published in pharmacology pharmacy followed by 837 (18.04%), 654 (14.10%), 337 (7.26%) and 323 (6.96%) were the second, third, fourth and fifth highest number of publication in chemistry, biochemistry molecular biology, biotechnology applied microbiology and oncology.

V. CONCLUSION

This study shows that there was no publication in the year 1989 and afterward the growth rate is being increased gradually and the highest number of publication was found in the year 2017. Among 16 different documents, articles were dominant with 3355 (72.4%). Among the top 10 authors, there is no Indian author to be listed out. In author collaboration, only 365 (6.5%) of the publications were made by single authors and remaining 93.5% of the articles were published by multiple authors, which shows high collaboration exists among the authors. In language-wise distribution, 4545 articles were published in English and country-wise distribution, USA contributed the most number of papers followed by China and India. Japan and Italy were the countries which contributed to the next number of articles. Pharmacology Pharmacy was the top research area in which a high number of articles 1542 (33.23) followed by Chemistry, Biochemistry Molecular Biology, Biotechnology Applied Microbiology, and Oncology were the other research areas in which many articles were published. It is interesting to note from the study that India stands third among country-wise publication, whereas no Indian author is being found among the top ten authors. The study also helps to know the area of research in which most publication occurred and high-quality journals.

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