

Indian Contribution to Drugs Discovery: A Scientometric Mapping of Publications

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ABSTRACT

Drug discovery (DD) is the process by which a novel drug is discovered for human well-being. According to nature.com, drug discovery is the process through which potential new medicines are identified. It involves a wide range of scientific disciplines, including biology, chemistry and pharmacology. Researchers wanted to carry out a Scientometric study on drug discovery with special reference to India and a total of 4850 records were downloaded from Web of Science database. Top 10 Institutions shared 1167 publications, 20 Institution shares of 1957 Publications and 50 Institution shares of 2944 out of 3573 Institutions. Council for Scientific and Industrial Research (CSIR) has the maximum output of 216 (4.5%) publications and recorded 3374 Global Citations Scores and stood at the first position in the table. Indian Institute of Technology (IITs) has produced 168 (3%) research publications followed by University of Delhi with 118 (2.4%) records. One of premier academic institute in India, Indian Institute of Science, Bengaluru (IISc) has produced 100 (2.1%) records in the drug discovery research. India has geographically collaborated with 91 countries and the highest number of publications with USA (486), Saudi Arabia (154), UK (107) and South Korea (103).

Keywords: Scientometrics; Bibliometrics; Drug Discovery; Citations; Highly Cited Papers;

INTRODUCTION

Research has always given breakthrough in last few decades. Research means growth in science & technology and it has increased productivity in day to day activities, betterment in layman's life. In Human evolution, nothing could have been attained without a single research. Whatever is being nowadays enjoyed is the result of research such as products, medicines, drugs, cloths, lights, cars, roads, facts, concepts, methods, mobile, television, etc. and so many things in research and development.

Scientific journals and magazines are indicators of scientific growth. Scientometric analysis is an important quantitative measures for the assessment of scientific productions. There are many definitions for the term "Scientometrics" in the literature; Scientometrics is the quantitative study of the disciplines of science based on published literature and communication. Scientometric study gives news ideas to explore in science and researchers are able to find out growth in research & development in Life Science, Pharmaceuticals, Agriculture, Chemical Sciences, animation, and list is going

on. Present study focuses on measuring the Indian research output of Drug Discovery (DD) using standard scientometric indicators. Study brings to meet the framed objectives.

REVIEW OF LITERATURE

Velvizhi, Murugesapandian, Surulinathi and Srinivasaragavan (2011) analysed the Indian literature output indexed in Web of Science during 1999–2011 on solar energy research. The area of solar fuels and Material sciences multidisciplinary has received maximum attention. Study reveals that during the 13 years period (1999–2011). India has produced a total of 1422 publications. The highest number of publications was 237 in 2010. The average number of publications per year was 5.4%. Out of 1422 contributors, single author has contributed 6.6 per cent of the total articles. 30 per cent of the contributions were published with two authors, 24.6 per cent of the contributions were contributed by three authors. 16.1 % of the publications were contributed by four authors. “Twari, GN” published highest number of articles during the study period with 70 records and 431 Global Citation Scores. In terms of collaboration in basic sciences, USA and South Korea are the major producers with India.

Poornima, Surulinathi, Amsaveni and Vijayaragavan (2011) analysed 1060 publications published by Indian scientists during 1998 to 2010 and indexed in WoS Database. This work is to provide a profile of research in Indian Research Publication in India. This includes tracking the number of papers, scatter of papers over journals, and its effect on publication output, authors’ institutional affiliations and authorship patterns. Study reveals that the highest publication is 146 in 2008 with 635 TGCS followed by 143 papers in 2007 with 1199 TGCS and 88 papers in 2006 with 713 TGCS. Centre Food Technology Research Institute, BARC, Indian Institute of Technology, Defense Food Research Lab and institutes are the major producers of research output. Most of the prolific authors are from the highly productive institutions. Relative growth rates have decreased gradually from 1.36 in 1998 to 0.04 in 2010. The whole study period records the mean relative growth rate of 0.20. Contrarily, the doubling time for publication of all sources of output has increased from 0.51 in 1998 to 19.8 in 2010. The doubling time for publications at the aggregate level has been computed as 10.03 years. The authorship pattern of Indian research productivity of food science and technology is multi-authored.

Karthick, Rajan and Rajaram (2017) made a Scientometric analysis of research output performance of Nanoscience research literature for a period from 2011 to 2016. A total of 21927 papers were published by the scientists in the field of Nanoscience research.

The average number of publications produced per year was 17%. The highest number of publications (236) was produced in 2013. The most productive author is Weiss PS with 17 papers dealing with Nanoscience research and 1.3% of all papers published in this research field. The highest number of publication is from USA and lowest number of publication is from Poland. The most productive journals were: the journal 'American Chemical Society Nano' topped with 53 publications with the Global Citation Score of 1076; 'Journal of Nanoparticle Research' has 34 publications with the Global Citation Score of 132 and 'Scientometrics' with 29 publications with the Global Citation Score of 230 respectively. 'Chemical Society Reviews' has scored the highest Global Citation Score of 3809 with 27 publications while 'Journal of Nanoscience and Nanotechnology' has scored a Global Citation Score of 97 with just 26 records.

Sankaralingam and Padma (2017) conducted a scientometric study on research output of biotechnology patents globally. A total of 1223 publications were downloaded from WoS database for the period of 18 years from 1989 to 2016. Thomas SM & Burke JF were ranked in top two positions with 15 & 11 records respectively. It is found that 'Research Policy' journal published 63 publications with 2991 global citations. USA contributed 373 total publications (30.4%) with citation score 11232 followed by UK & Canada with 127 & 72 publications respectively. Study reveals that h-index is 66, average citation per year is 15.44. A total of 78 publications were published in the year 2016 and average citation of the year 2016 is 43, top cited article was published by Owen-Smith, J. in Organization Science in 2014 which has got 602 citations.

Sankaralingam and Padma (2017) analysed the research productivity of systems biology research in India. A total of 1133 data were retrieved from WoS for the period of 26 years from 1991 to 2016. Researchers found that collected data had 20,393 Global Citation Score (GCS) and 72,122 cited references. They used HistCite and VOS viewer tools to analyze the most prolific authors, productive institutions and productive sources. The journal 'Current Science' is ranked first with 41 (3.6%) records and its global citations are 647 followed by Journals 'PLOS One' & Molecular Biosystems were ranked second (29, 2.6%) & third (16, 1.4%) respectively. Contribution by Indian scientists in Nucleic Acids Research (NAR) are 9 articles with GCS 1275. The study reveals that overall 1439 institutions contributed 1133 publications, out of 1439 institutes, the maximum number (88, 7.8%) papers with 1681 citations were produced by all the Indian Institute of Technology in India & it is ranked in first position and followed by Indian Institute of Science (IISc), Bangalore, India ranked in second position with 60 (5.3%) publications along with 1543 citations.

Sankaralingam and Padma (2016) conducted a scientometric study of global research productivity of Systems Biology (SB). A total of 11901 records on systems biology literature were downloaded from (WoS) database for the period of 10 years from 2006 to 2015. USA is the most prolific country contributing 41.5% followed by United Kingdom (14.4%). The top two journals were 'PLOS one' and 'Molecular Systems Biology' with 431 (4.64%) & 416 (4.48%) research publications respectively. The most productive publishers are BioMed Central (9.13%), Wiley Blackwell (7.72%) and Nature Publishing Group (6.73%). The research output was published in nine languages and English stands first (99.40%). Harvard University contributed 322 publications, the maximum from an institution and University of Manchester published 259 records. Nielson, J. is the highly prolific author with 94 records and stood first followed by Palsson, BO and Kell, DB published 65 & 62 records respectively.

METHODOLOGY

This study is based on the scientific productions in drug discovery with special reference to India as reflected in Web of Science (WOS) database that contains Social Science Citation Index (SSCI), Science Citation Index (SCI), and Arts and Humanities Citation Index (A&HCI). The time period considered in this study is from 1991 to 2020. A search was carried out in WOS database to get an overall picture of the size of the drug discovery literature. SSCI, SCI, and A&HCI were searched by topic field (drug discovery) and address field (India) by limiting it to the period between 1991 and 2020. The search was performed on 3rd August 2020. Finally, the evaluation was conducted based on parameters including authors, countries, institutions, journals, growth rate, document types, language, and subject areas. Biblioshiny application was used to analyse various co-networking among institutions, countries, authors, sources, etc. HistCite was used to generate tables of quantitative and qualitative analysis. VOS viewer was used to analyze the visualization of citations, co-authorship, etc.,

RESULTS AND FINDINGS

Country wise Research Collaboration of Indian Scientist

Country wise research collaboration of Indian scientists in drug discovery are listed in descending order in the below table 1. The most publications have been published with the country is USA i.e. 486 records and recorded 13660 Global Citation Scores followed by Saudi Arabia with 154 and recorded 2157 Citations and United Kingdom with 107 and

recorded 3243 Citations and South Korea with 103 and recorded 2562 Citations. 15 Countries are with more than 50 Publications and 14 Countries are recorded more than 1000 Citations. The range of Citation is 2-13660. 45 Countries are recorded more than 100 Citations and its shows the impact of research collaboration.

Table 1 Country wise Research Collaboration of Indian Scientist

#	Country	Publications	TGCS		Country	Publications	TGCS
1	USA	486	13660		New Zealand	6	168
2	Saudi Arabia	154	2157		Thailand	6	97
3	UK	107	3243		Algeria	5	41
4	South Korea	103	2562		Argentina	5	24
5	Germany	81	2506		Ireland	5	167
6	Peoples R China	81	1537		Mauritius	5	47
7	Italy	73	1675		Mexico	5	225
8	South Africa	65	833		Morocco	5	45
9	Australia	64	2383		Slovakia	5	51
10	Japan	57	1368		Unknown	5	118
11	Malaysia	53	932		Ghana	4	5
12	Switzerland	49	1493		Panama	4	97
13	Spain	46	1222		Qatar	4	59
14	Canada	44	751		Ukraine	4	11
15	France	39	1043		Chile	3	2
16	Russia	38	590		Indonesia	3	10
17	Sweden	38	840		Norway	3	62
18	Belgium	36	1017		Oman	3	12
19	Taiwan	33	509		Tunisia	3	2
20	Brazil	28	734		Vietnam	3	39
21	Turkey	24	384		Yemen	3	33
22	Singapore	23	610		Croatia	2	30
23	Egypt	22	177		Estonia	2	39
24	Iran	21	265		Kenya	2	119
25	Netherlands	19	1226		Luxembourg	2	117
26	Portugal	18	527		Slovenia	2	26
27	Czech Republic	16	284		Tanzania	2	0
28	Finland	16	712		Trinidad Tobago	2	22
29	Denmark	15	741		Bahrain	1	9
30	Pakistan	13	178		Colombia	1	57
31	Poland	13	181		Cote Ivoire	1	8
32	U Arab Emirates	13	97		Cuba	1	20
33	Israel	12	331		Curacao	1	0
34	Austria	11	497		Cyprus	1	57
35	Serbia	11	149		Kazakhstan	1	0
36	Greece	9	363		Lithuania	1	3
37	Jordan	9	59		Moldova	1	40
38	Bulgaria	8	93		Myanmar	1	23
39	Romania	8	97		Namibia	1	6
40	Bangladesh	7	75		North Korea	1	17
41	Cameroon	7	98		North Macedonia	1	5
42	Ethiopia	7	95		Philippines	1	40
43	Nigeria	7	66		Sudan	1	11
44	Hungary	6	188		Venezuela	1	2
45	Iraq	6	22		Zambia	1	115
46	Nepal	6	88		Zimbabwe	1	115

Institution wise distribution of Publications

A total of 3573 institutions have contributed their research output in drug discovery and they have produced 4850 records (including collaborations Institutions from all over the world). Table displays the most productive institutions in the drug discovery research, in the analysis, Council for Scientific and Industrial Research (CSIR) has the maximum output of 216 (4.5%) publications and recorded 3374 Global Citations Scores and stood at the first position in the table. Indian Institute of Technology (IITs) has produced 168 (3%) research publications followed by University of Delhi with 118 (2.4%) records. One of premier academic institute in India, Indian Institute of Science, Bengaluru (IISc) has produced 100 (2.1%) records in the drug discovery research. The study found 24 Institutions are recorded the highest number of Citations with 1000. In Tamilnadu 13 Institutions are contributed more than 20 Publications. VIT has produced 93 publications and recorded 1318 Citations with high impact followed by Alagappa University with 58 (660 Citations), Madurai Kamaraj University 38 (1094 Citations) and University of Madras with 37 Publication and recorded 265 Citations.

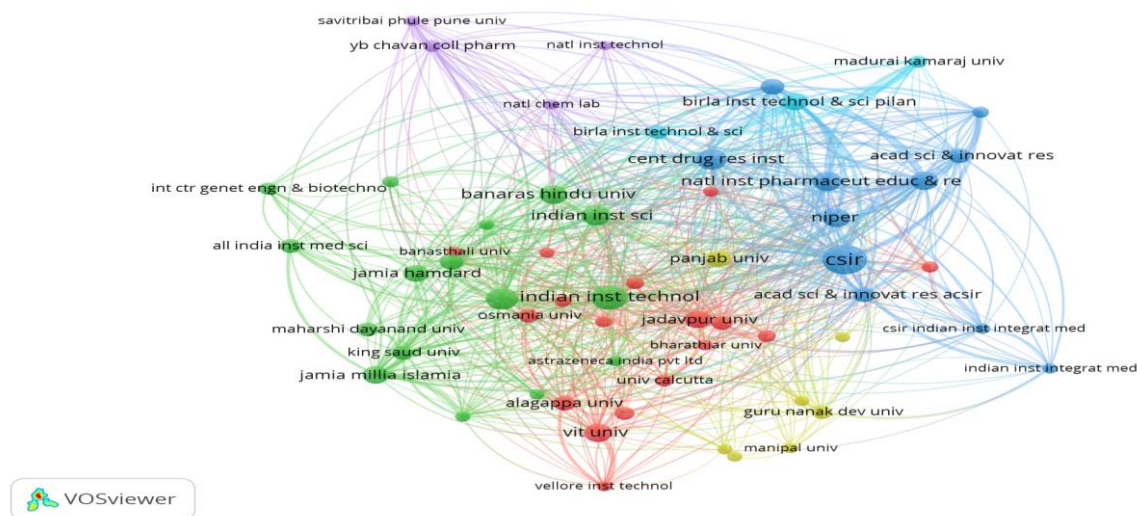


Figure 1: Citation-wise visualization of organizations: Above figure displays the network visualization of organization in drug discovery research.

Table 2 Institution wise distribution of Publications

S.No.	Institution	Records	Percent	TLCS	TGCS
1	CSIR	216	4.5	174	3374
2	Indian Institute of Technology (IITs)	168	3.5	86	2750
3	University of Delhi	118	2.4	132	1829
4	Centre for Drug Research Institute	111	2.3	127	2554
5	Indian Institute of Science	100	2.1	81	1990
6	National Institute of Pharmaceutical Education & Research	97	2.0	111	2424

7	VIT University	93	1.9	81	1318
8	Indian Institute of Chemical Technologies	90	1.9	230	2516
9	Banaras Hindu University	89	1.8	101	2547
10	NIPER	85	1.8	70	1237
11	Birla Inst Technol & Sci Pilani	80	1.6	171	1458
12	Jadavpur University	79	1.6	82	1237
13	Jamia Millia Islamia	78	1.6	116	1322
14	Jamia Hamdard	72	1.5	42	851
15	Panjab University	71	1.5	33	879
16	CSIR Cent Drug Res Inst	66	1.4	62	760
17	Jawaharlal Nehru University	66	1.4	103	1420
18	Acad Sci & Innovat Res AcSIR	60	1.2	25	533
19	Alagappa University	58	1.2	83	660
20	Acad Sci & Innovat Res	57	1.2	30	455
21	University Hyderabad	53	1.1	35	1033
22	King Saud University	50	1.0	21	643
23	All India Inst Med Science	49	1.0	27	1171
24	Osmania University	49	1.0	34	438
25	Maharshi Dayanand University	48	1.0	21	320
26	Guru Nanak Dev University	47	1.0	43	835
27	Pondicherry University	44	0.9	33	469
28	Birla Inst Technol & Science	42	0.9	73	684
29	Birla Inst Technology	40	0.8	35	686
30	Int Ctr Genet Engn & Biotechnol	40	0.8	17	435
31	Madurai Kamaraj University	38	0.8	71	1094
32	University Calcutta	38	0.8	17	340
33	University of Madras	37	0.8	20	265
34	YB Chavan Coll Pharm	36	0.7	62	395
35	CSIR Indian Inst Chem Technol	33	0.7	29	295
36	Aligarh Muslim University	32	0.7	25	632
37	Nirma University	32	0.7	22	667
38	Cent Univ Rajasthan	31	0.6	20	274
39	Indian Inst Chem Biology	31	0.6	28	780
40	Bharathiar University	30	0.6	11	259

Scholarly Communication Channels

A total of 3444 publications (71.0%) are articles published in Drug Discovery. Reviews are 1146 (23.6%), followed by Article; Early Access with 81(1.7), Editorial Material with 71 (1.5%), and remaining less than one percent of Publications are published different forms. The study found that Drug Discovery publications are shared in 16 forms.

Table 3 shows Scholar Communication Channels

#	Document Type	Records	Percent	TLCS	TGCS
1	Article	3444	71.0	2910	48682
2	Review	1146	23.6	891	29497
3	Article; Early Access	81	1.7	0	173
4	Editorial Material	71	1.5	27	776
5	Article; Proceedings Paper	32	0.7	22	273
6	Meeting Abstract	31	0.6	1	20
7	Review; Book Chapter	16	0.3	14	192
8	Letter	12	0.2	9	78
9	Review; Early Access	5	0.1	0	15
10	Article; Book Chapter	4	0.1	1	29

11	News Item	2	0.0	0	0
12	Review; Retracted Publication	2	0.0	3	125
13	Article; Retracted Publication	1	0.0	0	0
14	Biographical-Item	1	0.0	0	1
15	Correction	1	0.0	0	0
16	Reprint	1	0.0	0	0

Source Title Wise Distribution of Publications and Citations

In the study, highly productive journals of Drug Discovery research papers were identified in 939 Source Titles. Table 4 indicated below shows the impact of the most productive journals. European Journal of Medicinal Chemistry is the highly productive journal with 206 (4.2%) publications and recorded 6526 Citations (291 Cited references), followed by Journal of Biomolecular Structure and Dynamics with 144 (3.0%) publications and received 1003 Citations (260 Cited references), bioorganic and medicinal Chemistry Letters with 134 (2.8%), Medicinal Chemistry Research with 125(2.6%) publications.

It is found that 11 journals are recorded 1003-6526 Global Citations Scores and EUROPEAN JOURNAL OF MEDICINAL CHEMISTRY has the highest number Citations with 6526 followed by BIOORGANIC & MEDICINAL CHEMISTRY LETTERS with 2727, BIOORGANIC & MEDICINAL CHEMISTRY with 2162 and JOURNAL OF MEDICINAL CHEMISTRY with 2019 Citations. 433 Source titles are recorded 100 and above Citations.

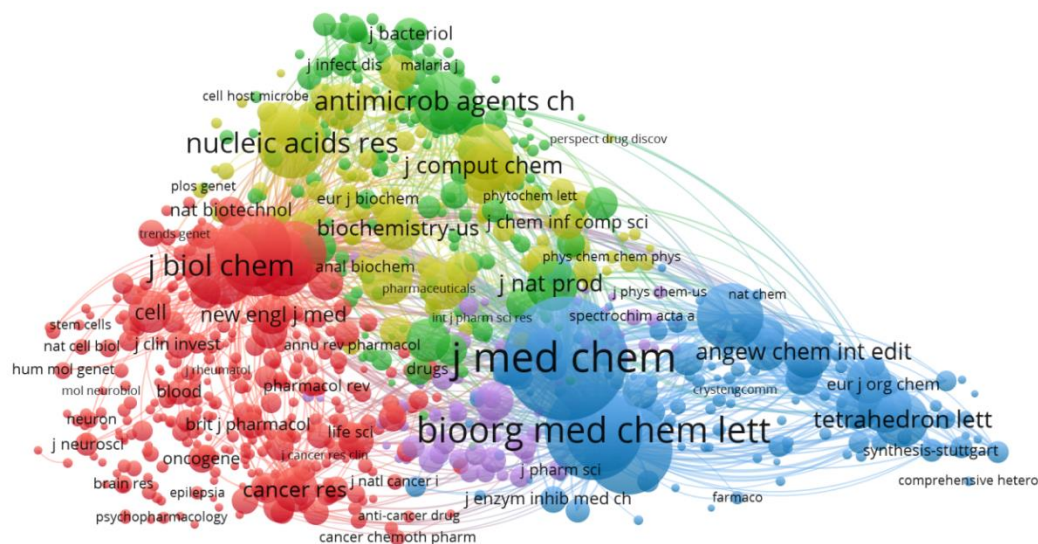


Figure 2: network visualization of highly productive sources
Table 4 shows Source Title wise distribution of Publications

#	Journal	Records	%	TGCS	TLCR
1	EUROPEAN JOURNAL OF MEDICINAL CHEMISTRY	206	4.2	6526	291
2	JOURNAL OF BIOMOLECULAR STRUCTURE & DYNAMICS	144	3.0	1003	260
3	BIOORGANIC & MEDICINAL CHEMISTRY LETTERS	134	2.8	2727	166

4	MEDICINAL CHEMISTRY RESEARCH	125	2.6	940	101
5	CURRENT TOPICS IN MEDICINAL CHEMISTRY	96	2.0	986	127
6	RSC ADVANCES	85	1.8	1469	90
7	BIOORGANIC & MEDICINAL CHEMISTRY	73	1.5	2162	70
8	PLOS ONE	66	1.4	940	46
9	BIOORGANIC CHEMISTRY	61	1.3	627	90
10	LETTERS IN DRUG DESIGN & DISCOVERY	59	1.2	159	42
11	JOURNAL OF MEDICINAL CHEMISTRY	58	1.2	2019	53
12	CHEMICAL BIOLOGY & DRUG DESIGN	57	1.2	723	50
13	COMBINATORIAL CHEMISTRY & HIGH THROUGHPUT SCREENING	51	1.1	447	73
14	MINI-REVIEWS IN MEDICINAL CHEMISTRY	50	1.0	650	59
15	SCIENTIFIC REPORTS	49	1.0	492	36
16	JOURNAL OF MOLECULAR GRAPHICS & MODELLING	47	1.0	504	38
17	CHEMISTRYSELECT	45	0.9	200	44
18	CURRENT COMPUTER-AIDED DRUG DESIGN	44	0.9	160	35
19	CURRENT SCIENCE	42	0.9	779	29
20	EXPERT OPINION ON DRUG DISCOVERY	42	0.9	495	31
21	COMPUTATIONAL BIOLOGY AND CHEMISTRY	38	0.8	322	37
22	CURRENT PHARMACEUTICAL DESIGN	37	0.8	561	43
23	TETRAHEDRON LETTERS	35	0.7	756	22
24	MEDCHEMCOMM	34	0.7	533	36
25	ORGANIC & BIOMOLECULAR CHEMISTRY	34	0.7	452	26
26	JOURNAL OF MOLECULAR STRUCTURE	33	0.7	147	33
27	ARCHIV DER PHARMAZIE	32	0.7	329	43
28	CURRENT MEDICINAL CHEMISTRY	32	0.7	695	38
29	INTERNATIONAL JOURNAL OF BIOLOGICAL MACROMOLECULES	32	0.7	310	31
30	CURRENT DRUG TARGETS	30	0.6	288	31

Year-wise Publication and Citation Impact

Table 5 shows the year-wise distribution of drug discovery research for a period from 1991 to 2020 in two categories i.e. publications-wise impact and citations-wise impact. A total of 4850 records were found in WoS database for the study period. The maximum output was occurred in the year 2018 numbering 668 publications (4714 citations) and this formed 13.8% of the total output followed by 586 (12.1%) records in the year 2019 and 577 (11.9%) records in the year 2017 with the citations of 1865 & 6239 respectively. The least count of the total output was found in three years (1991, 1995, and 1996) with 1 record each. It is found that in numerical count, research literature output in DD research registered a gradual increase from 1991 to 2018 excepting the fall during 2002, 2019-2020. The number of articles in the years from 1991 to 2008 is less than 100 outputs. In citation-wise impact, the maximum citations of 9132 was found in the year 2013 for 345 records followed by 7983 citations (394 records) in the year 2014, 6787 (398 records) citations in the year 2015.

Table 5: Year-wise Publication and Citation Impact

#	Publication Impact				#	Citation Impact			
	Year	Records	%	TGCS		Year	Records	%	TGCS
1	1991	1	0.0	7		2013	345	7.1	9132

2	1992	2	0.0	0	2014	394	8.1	7983
3	1995	1	0.0	3	2015	398	8.2	6787
4	1996	1	0.0	41	2017	577	11.9	6239
5	1997	3	0.1	54	2016	459	9.5	6087
6	1998	7	0.1	497	2012	235	4.8	5553
7	1999	4	0.1	38	2011	180	3.7	5542
8	2000	7	0.1	44	2018	668	13.8	4714
9	2001	15	0.3	1208	2009	123	2.5	4699
10	2002	8	0.2	203	2010	140	2.9	3980
11	2003	18	0.4	1511	2008	97	2.0	3017
12	2004	32	0.7	3014	2004	32	0.7	3014
13	2005	37	0.8	2002	2007	65	1.3	2686
14	2006	47	1.0	2547	2006	47	1.0	2547
15	2007	65	1.3	2686	2005	37	0.8	2002
16	2008	97	2.0	3017	2019	586	12.1	1865
17	2009	123	2.5	4699	2003	18	0.4	1511
18	2010	140	2.9	3980	2001	15	0.3	1208
19	2011	180	3.7	5542	1998	7	0.1	497
20	2012	235	4.8	5553	2020	314	6.5	220
21	2013	345	7.1	9132	2002	8	0.2	203
22	2014	394	8.1	7983	1997	3	0.1	54
23	2015	398	8.2	6787	2000	7	0.1	44
24	2016	459	9.5	6087	1996	1	0.0	41
25	2017	577	11.9	6239	1999	4	0.1	38
26	2018	668	13.8	4714	1991	1	0.0	7
27	2019	586	12.1	1865	1995	1	0.0	3
28	2020	314	6.5	220	1992	2	0.0	0

Publication and Citation Impact of Authors

Table 6 shows the top 25 highly prolific authors in terms of number of publications and citations in drug discovery research in India. Kumar, A. is the highly productive author with 123 records and the second highest numbers of publications have been contributed by Singh, S., with 98 records followed by Kumar, S., with 91 records. In terms of citation-wise output, Pandey, A. has the maximum Total Global Citation Score (TGCS) of 2306 followed by Ghosh D with the TGCS of 1982, Sriram D with the TGCS of 1940 and Yogeeswari P with the TGCS of 1832. There are two authors with the TGCS of 1806 and 6 authors with the TGCS of 1803.

Table 6 shows that Publication and Citation Impact of Authors

Publications Impact				Citation Impact		
#	Author	Records	TGCS	Author	Records	TGCS
1	Kumar A	123	1806	Pandey A	16	2306
2	Singh S	98	1304	Ghosh D	5	1982
3	Kumar S	91	913	Sriram D	83	1940
4	Sharma A	90	1237	Yogeeswari P	61	1832
5	Sriram D	83	1940	Kumar A	123	1806
6	Kumar V	71	983	Shanker K	3	1806
7	Sharma S	70	1489	Barrette T	1	1803
8	Singh SK	66	840	Chinnaiyan AM	1	1803

9	Yogeeswari P	61	1832	Deshpande N	1	1803
10	Gupta S	60	977	Rhodes DR	1	1803
11	Kumar R	58	1403	Varambally R	1	1803
12	Singh A	53	376	Yu JJ	1	1803
13	Singh P	50	858	Sharma S	70	1489
14	Kumar M	38	535	Sastry GM	2	1413
15	Kumar P	38	293	Sherman W	2	1413
16	Kumar N	37	968	Kumar R	58	1403
17	Hassan MI	35	488	Adzhigirey M	1	1362
18	Kumar D	34	422	Annabhimoju R	1	1362
19	Saxena AK	34	710	Day T	1	1362
20	Vishwakarma RA	32	474	Singh S	98	1304
21	Singh M	31	377	Sharma A	90	1237
22	Roy K	29	609	Patwardhan B	20	1145
23	Sharma M	29	463	Rahman I	2	1037
24	Das S	28	368	Biswas SK	1	1035
25	Khan F	27	370	Kode A	1	1035

Highly Cited Papers

Table 7 shows the highly productive article based on citations received and the top three articles received more than 1000 citations. An article titled “ONCOMINE: A cancer microarray database and integrated data-mining platform (record no. 159) received the maximum of 1803 Global Citation Scores (GCS)”. The second highest cited article is “Protein and ligand preparation: parameters, protocols, and influence on virtual screening enrichments”. It has received 1362 GCS (record no. 1209).

Table 7 shows that Highly cited papers based on GCS

#	Date / Author / Journal	LCS	GCS	LCR	CR
1	159 Rhodes DR, Yu JJ, Shanker K, Deshpande N, Varambally R, et al., ONCOMINE: A cancer microarray database and integrated data-mining platform, NEOPLASIA. 2004 JAN-FEB; 6 (1): 1-6	2	1803	0	46
2	1209 Sastry GM, Adzhigirey M, Day T, Annabhimoju R, Sherman W, Protein and ligand preparation: parameters, protocols, and influence on virtual screening enrichments, JOURNAL OF COMPUTER-AIDED MOLECULAR DESIGN. 2013 MAR; 27 (3): 221-234	80	1362	0	82
3	227 Rahman I, Kode A, Biswas SK, Assay for quantitative determination of glutathione and glutathione disulfide levels using enzymatic recycling method NATURE PROTOCOLS. 2006; 1 (6): 3159-3165	0	1035	0	23
4	1693 Kumari R, Kumar R, Lynn A, g_mmpbsa-A GROMACS Tool for High-Throughput MM-PBSA Calculations, JOURNAL OF CHEMICAL INFORMATION AND MODELING. 2014 JUL; 54 (7): 1951-1962	59	876	0	102
5	837 Agalave SG, Maujan SR, Pore VS, Click Chemistry: 1,2,3-Triazoles as Pharmacophores, CHEMISTRY-AN ASIAN JOURNAL. 2011 OCT 4; 6 (10): 2696-2718	23	726	1	218
6	1284 Kaushik NK, Kaushik N, Attri P, Kumar N, Kim CH, et al., Biomedical Importance of Indoles, MOLECULES. 2013 JUN; 18 (6): 6620-6662	9	521	2	131
7	294 Mehta SL, Manhas N, Rahubir R., Molecular targets in cerebral ischemia for developing novel therapeutics, BRAIN RESEARCH REVIEWS. 2007 APR; 54 (1): 34-66	2	503	0	393

8	126Watve MG, Tickoo R, Jog MM, Bhole BD, How many antibiotics are produced by the genus <i>Streptomyces</i> ?, ARCHIVES OF MICROBIOLOGY. 2001 NOV; 176 (5): 386-390	6	492	0	27
9	826Mishra BB, Tiwari VK, Natural products: An evolving role in future drug discovery, EUROPEAN JOURNAL OF MEDICINAL CHEMISTRY. 2011 OCT; 46 (10): 4769-4807	22	474	1	450
10	113Rao CNR, Cheetham AK, Science and technology of nanomaterials: current status and future prospects, JOURNAL OF MATERIALS CHEMISTRY. 2001; 11 (12): 2887-2894	0	440	0	80

Highest Collaboration papers

Table 8 indicates the highly productive authors based on Number of authors contributed in single paper. Su ZQ, et. al. for the article titled “A comprehensive assessment of RNA-seq accuracy, reproducibility and information content by the Sequencing Quality Control Consortium” has contributed by 162 authors, followed by Discovery of a Potent Acyclic, Tripeptidic, AcylSulfonamideInhibitor of Hepatitis C Virus NS3Protease as a Back-up to Asunaprevir with the Potential for Once-DailyDosing, contributed by 56 authors and remaining authors. The study found that 11 paper contributed by more than 50 authors and 463 publication with more than 10 authors

Table 8 shows that Highest Collaboration Papers

#	<u>Date / Author / Journal</u>	<u>GCS</u>	<u>NA</u>	<u>LCR</u>	<u>CR</u>
1	1756Su ZQ, Labaj PP, Li S, Thierry-Mieg J, Thierry-Mieg D, et al., A comprehensive assessment of RNA-seq accuracy, reproducibility and information content by the Sequencing Quality Control Consortium NATURE BIOTECHNOLOGY. 2014 SEP; 32 (9): 903-914	418	162	0	46
2	2595Sun LQ, Mull E, Zheng B, D'Andrea S, Zhao Q, et al. Discovery of a Potent Acyclic, Tripeptidic, AcylSulfonamideInhibitor of Hepatitis C Virus NS3Protease as a Back-up to Asunaprevir with the Potential for Once-DailyDosing, JOURNAL OF MEDICINAL CHEMISTRY. 2016 SEP 8; 59 (17): 8042-8060	11	56	0	48
3	139Terwilliger TC, Park MS, Waldo GS, Berendzen J, Hung LW, et al., The TB structural genomics consortium: a resource for Mycobacterium tuberculosis biology TUBERCULOSIS. 2003; 83 (4): 223-249	87	54	0	131
4	2909Tantry SJ, Markad SD, Shinde V, Bhat J, Balakrishnan G, et al., Discovery of Imidazo[1,2-a]pyridine Ethers and Squaramides as Selective and Potent Inhibitors of Mycobacterial Adenosine Triphosphate (ATP) Synthesis JOURNAL OF MEDICINAL CHEMISTRY. 2017 FEB 23; 60 (4): 1379-1399	38	54	0	51
5	2641Williamson AE, Ylloja PM, Robertson MN, Antonova-Koch Y, Avery V, et al., OpenSourceDrugDiscovery: Highly Potent Antimalarial Compounds Derived from the TresCantos Arylpyrroles, ACS CENTRAL SCIENCE. 2016	27	53	1	102

	OCT 26; 2 (10): 687-701				
6	<u>2968</u> Paquet T, Le Manach C, Cabrera DG, Younis Y, Henrich PP, et al., <u>Antimalarial efficacy of MMV390048, an inhibitor of Plasmodium phosphatidylinositol 4-kinase</u> <u>SCIENCE TRANSLATIONAL MEDICINE</u> . 2017 APR 26; 9 (387): Art. No. ead9735	67	53	0	52
7	<u>3773</u> Puyang XL, Furman C, Zheng GZ, Wu ZHJ, Banka D, et al., <u>Discovery of Selective Estrogen Receptor Covalent Antagonists for the Treatment of ER α(WT) and ER α(MUT) Breast Cancer</u> , <u>CANCER DISCOVERY</u> . 2018 SEP; 8 (9): 1176-1193	13	53	0	39
8	<u>4536</u> Chiba S, Ohue M, Gryniukova A, Borysko P, Zozulya S, et al., <u>A prospective compound screening contest identified broader inhibitors for Sirtuin 1</u> , <u>SCIENTIFIC REPORTS</u> . 2019 DEC 20; 9: Art. No. 19585	0	53	0	71
9	<u>2634</u> Kato N, Comer E, Sakata-Kato T, Sharma A, Sharma M, et al., <u>Diversity-oriented synthesis yields novel multistage antimalarial inhibitors</u> <u>NATURE</u> . 2016 OCT 20; 538 (7625): 344-+	106	52	0	72
10	<u>4480</u> Marcoux D, Duan JJW, Shi Q, Cherney RJ, Srivastava AS, et al., <u>Rationally Designed, Conformationally Constrained Inverse Agonists of RORγ t-Identification of a Potent, Selective Series with Biologic-Like in Vivo Efficacy</u> <u>JOURNAL OF MEDICINAL CHEMISTRY</u> . 2019 NOV 14; 62 (21): 9931-9946	5	51	1	76
11	<u>2983</u> Gaur AS, Bhardwaj A, Sharma A, John L, Vivek MR, et al., <u>Assessing therapeutic potential of molecules: molecular property diagnostics suite for tuberculosis</u> , <u>JOURNAL OF CHEMICAL SCIENCES</u> . 2017 MAY; 129 (5): 515-531	4	50	7	83

Country-wise collaboration of India

Table 8 and Figure 3 display the country-wise collaboration of Indian researchers in DD research. India and USA have produced the maximum research publications of 485 and stood first in the table, while India and Saudi Arabia have published 155 records and 110 research publications were produced by India and China. India has produced 104 and 103 research outputs with Korea and United Kingdom respectively. India has also collaborated with the other countries like Germany, Italy, South Africa, Australia and Japan and produced less than 100 records.

Table 8: Country-wise collaboration of India Scientists

INDIA	USA	485	INDIA	SWEDEN	38
INDIA	SAUDI ARABIA	155	INDIA	BELGIUM	36
INDIA	CHINA	110	INDIA	BRAZIL	28
INDIA	KOREA	104	INDIA	TURKEY	24
INDIA	UNITED KINGDOM	103	INDIA	SINGAPORE	23

INDIA	GERMANY	81	INDIA	EGYPT	22
INDIA	ITALY	73	INDIA	IRAN	21
INDIA	SOUTH AFRICA	65	INDIA	NETHERLANDS	19
INDIA	AUSTRALIA	63	INDIA	PORTUGAL	18
INDIA	JAPAN	57	INDIA	DENMARK	17
INDIA	MALAYSIA	54	INDIA	CZECH REPUBLIC	16
INDIA	SWITZERLAND	49	INDIA	FINLAND	16
INDIA	SPAIN	45	INDIA	PAKISTAN	13
INDIA	CANADA	43	INDIA	POLAND	13
INDIA	FRANCE	39	INDIA	U ARAB EMIRATES	13
INDIA	RUSSIA	38	INDIA	ISRAEL	12

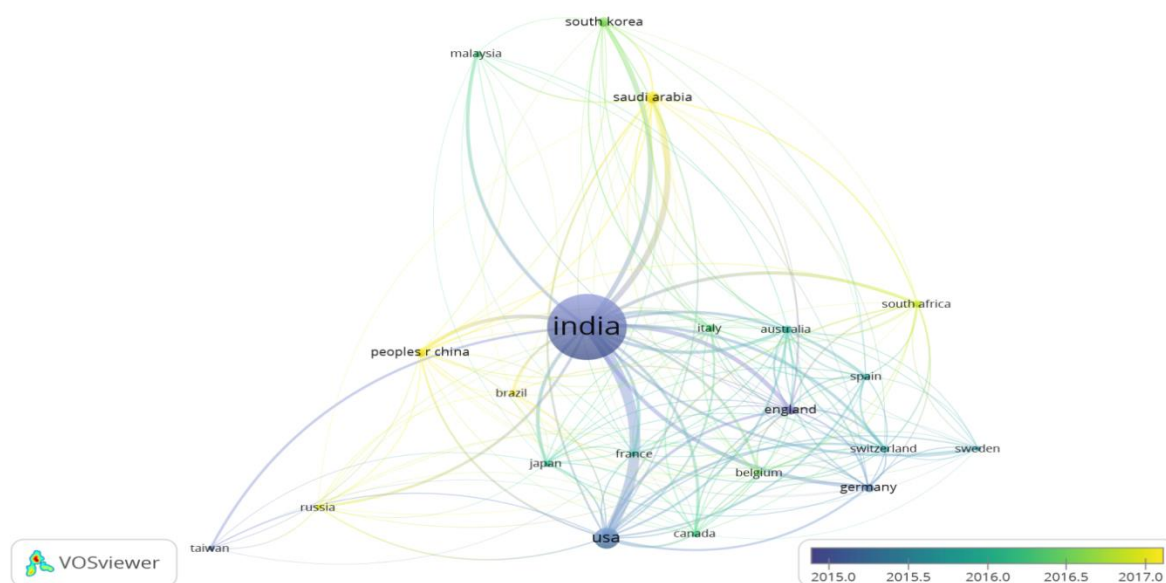


Figure 3: Co-authorship of India & Rest of the world

Factorial Analysis: Topic Dendrogram

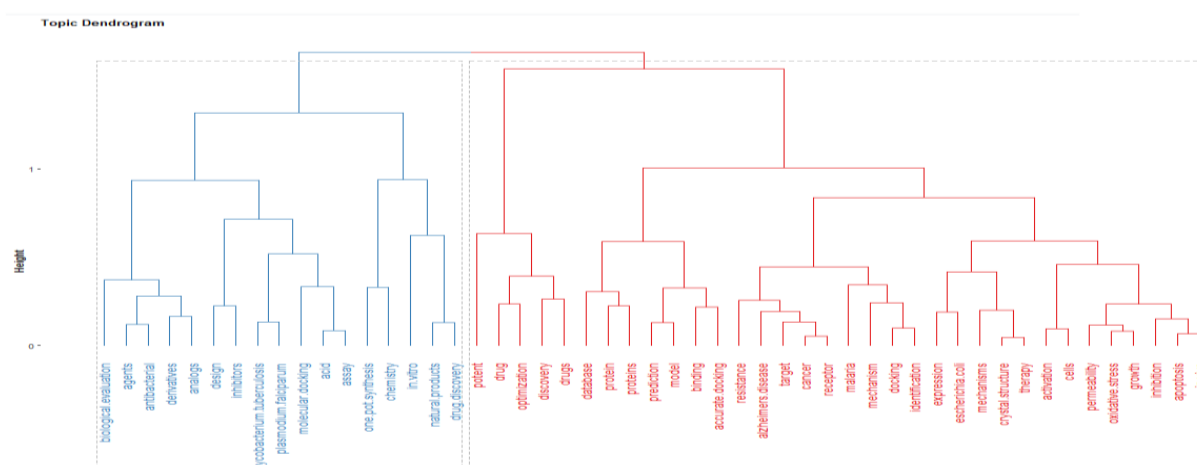


Figure 4 factorial analysis

Lotka's Law of Author Productivity

Lotka's law mainly explains the distribution of research literature of various authors' productivity in a given field (Lotka 1926). It finds that most articles are being contributed by a few researchers, with a large proportion of researchers contributing to just one publication. It states that "the number of authors making n contribution is about $1/n^2$ of those making one publication and the proportion of all contributors that make a single contribution is about 60 percent" (Lotka 1926), as cited by Potter (1988). In brief, the author who publishes two articles accounts on average for $1/4^{\text{th}}$ of the total number of publications. The authors who publish three articles account for about $1/9^{\text{th}}$ of the total number of publications and so on. Therefore, authors who publish one article account for 60% of all the publications.

Table 9: Lotka's law of Author Productivity in drug discovery research

Documents written	N. of Authors	Proportion of Authors	Documents written	N. of Authors	Proportion of Authors
1	10186	0.718538375	26	3	0.000211625
2	2014	0.142071106	27	4	0.000282167
3	798	0.056292325	28	1	7.05418E-05
4	383	0.027017494	29	3	0.000211625
5	221	0.015589729	31	1	7.05418E-05
6	136	0.009593679	32	1	7.05418E-05
7	90	0.006348758	34	2	0.000141084
8	69	0.004867381	35	1	7.05418E-05
9	48	0.003386005	37	1	7.05418E-05
10	41	0.002892212	38	2	0.000141084
11	27	0.001904628	50	1	7.05418E-05
12	22	0.001551919	53	1	7.05418E-05
13	21	0.001481377	58	1	7.05418E-05
14	15	0.001058126	60	1	7.05418E-05
15	18	0.001269752	61	1	7.05418E-05
16	15	0.001058126	66	1	7.05418E-05
17	12	0.000846501	70	1	7.05418E-05
18	5	0.000352709	71	1	7.05418E-05
19	5	0.000352709	83	1	7.05418E-05
20	4	0.000282167	90	1	7.05418E-05
22	6	0.000423251	91	1	7.05418E-05
23	6	0.000423251	98	1	7.05418E-05
24	1	7.05418E-05	124	1	7.05418E-05
25	1	7.05418E-05			

Conventional	Number of Expected Contributions	Number of Expected Authors	Actual Number of Authors
60	1	8505	10186
1/4	2	3544	2014
1/9	3	1575	798

Table 9 shows the Testing of application of the Lotka's law,

As per the convention (Lotka and Tsay), Lotka's law of author productivity predicts that in a given quantum of literature of a particular discipline, 60% of the authors contribute 1 publication, 1/4th of the authors 2 articles, 1/9th of the authors contribute 3 articles and so on.

Total number of authors in drug discovery research during 1991-2020: 14176

Total number of records in drug discovery research during 1991-2020: 4850

The actual number of authors deviate quite a lot from the expected number of authors who contributed one or two or three or six records in DD research output 1991-2020. Thus it is proved that DD research output during 1991-2020 does not fit into Lotka's law of author productivity.

H-index – Highly Prolific Author

Table 10 displays the h-index of select 20 authors, whose h-index is minimum 10 in drug discovery research output. The highest h-index of 20 was secured by Kumar, A. and his 121 publications received 1737 citations and g-index is 36. He is followed by Singh, S. with h-index and g-index are 16 and 32 respectively. Singh's 97 publications received a total citations of 1304. While Kumar, S. has a total citations of 898 of 89 publications to reach the h-index of 16 and his g-index is 25.

Table 10 H-index of highly prolific authors in drug discovery research

Author	h_index	g_index	m_index	TC	NP	PY_start
KUMAR A	20	36		1737	121	2000
SINGH S	16	32		1304	97	2004
KUMAR S	16	25	0.88	898	89	2003
SHARMA A	18	30	1.05	1101	86	2004
SRIRAM D	25	42		1940	83	2004
KUMAR V	17	28	1.21	983	71	2007
SHARMA S	20	36		1489	70	2003
SINGH SK	15	26		834	65	2004
YOGESHWARI P	25	41	1.47	1832	61	2004
GUPTA S	19	29		955	59	2005
KUMAR R	14	37	0.87	1401	57	2005
SINGH A	11	16		376	53	2013

SINGH P	13	28		858	50	2006
KUMAR M	10	22		535	38	2009
KUMAR P	11	15		292	37	2010
KUMAR N	11	31		968	37	2008
HASSAN MI	13	21		488	35	2013
KUMAR D	12	19		422	34	2010
SAXENA AK	12	26	0.6	710	34	2001
VISHWAKARMA RA	14	20	1.16	474	32	2009

Year-wise distribution of Source Dynamics

Table 11 displays the year-wise distribution of the top ten sources and the occurrence of articles first published. The journal 'Bioorganic & Medicinal Chemistry Letters' (BMCL) has the highest number of publications in the year 2020 with 134 records and lowest output (1) record in 1998 and there are no records found from 1991 to 1997. The journal 'European Journal of Medicinal Chemistry' (EJMC) has published the maximum output (206 records) in 2020 and lowest output (1) records in 2004. The journal 'Bioorganic & Medicinal Chemistry' (BMC) received the highest output in the year 2020 with 73 and lowest in 2002-2004 with 1 record each. The journal 'Bioorganic Chemistry' published articles from 2012 to 2020, there were no single articles published from the year 1991 to 2011.

Table 11: Year-wise distribution of Source

Year	BIOORGANIC & MEDICINAL CHEMISTRY LETTERS	EUROPEAN JOURNAL OF MEDICINAL CHEMISTRY	BIOORGANIC & MEDICINAL CHEMISTRY	JOURNAL OF BIOMOLECULAR STRUCTURE & DYNAMICS	MEDICINAL CHEMISTRY RESEARCH	BIOORGANIC CHEMISTRY	RSC ADVANCES	PLOS ONE	LETTERS IN DRUG DESIGN & DISCOVERY	CURRENT TOPICS IN MEDICINAL CHEMISTRY
1991	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0
1998	1	0	0	0	0	0	0	0	0	0
1999	2	0	0	0	0	0	0	0	0	0
2000	2	0	0	0	0	0	0	0	0	0
2001	2	0	0	0	1	0	0	0	0	0
2002	2	0	1	0	1	0	0	0	0	0
2003	3	0	1	0	1	0	0	0	0	0
2004	4	1	1	1	3	0	0	0	0	0
2005	4	2	3	1	3	0	0	0	0	0
2006	8	2	4	2	3	0	0	0	0	0
2007	9	3	6	2	4	0	0	0	0	0
2008	10	4	7	2	5	0	0	0	0	0

2009	15	11	14	3	5	0	0	1	3	0
2010	18	17	18	4	10	0	0	4	3	2
2011	26	26	19	5	15	0	1	6	7	3
2012	36	36	22	5	31	1	4	11	12	8
2013	46	50	25	8	56	1	10	19	15	14
2014	61	71	31	9	78	4	19	29	18	21
2015	74	94	40	14	93	4	38	47	22	25
2016	94	118	46	24	98	7	64	54	30	37
2017	111	135	54	38	108	12	71	57	39	51
2018	123	161	62	54	119	23	76	62	47	72
2019	130	190	70	78	121	48	81	65	54	93
2020	134	206	73	95	125	61	85	66	59	96

Three fields plot of affiliations, sources & author

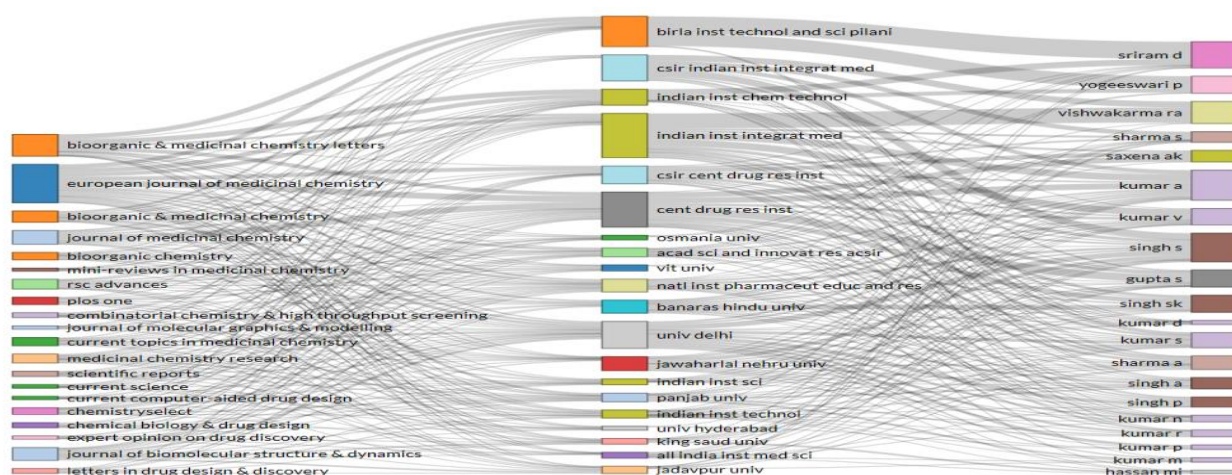


Figure 5 displays the three fields plot analysis to bring out the connection network of an author and his collaboration with institutions to publish articles in reputed sources or journals.

Three field Plot (country, affiliations, authors)

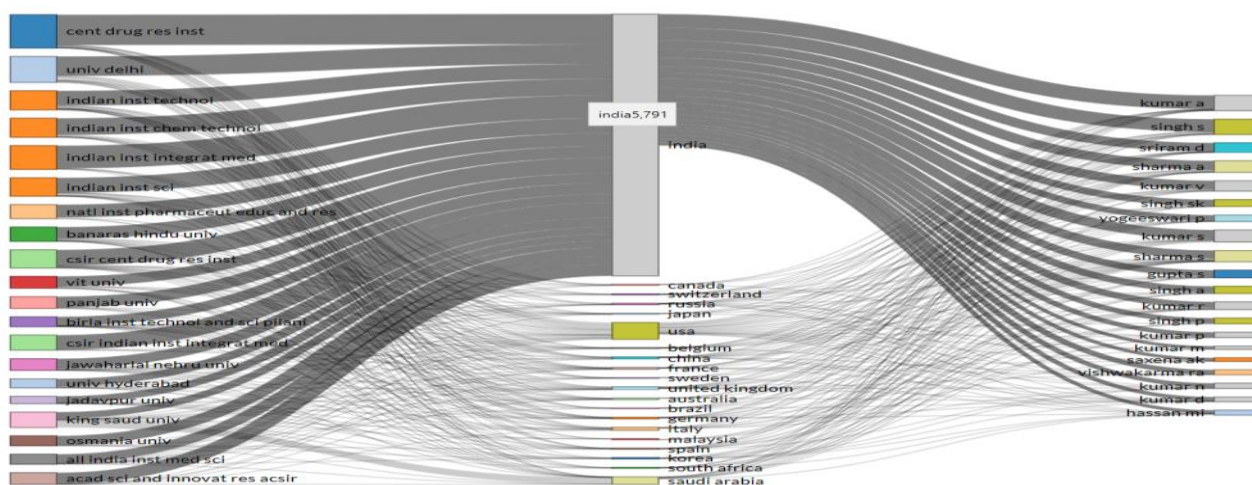


Figure 6 displays the three fields plot analysis to showcase the research output of India and its affiliations

Funding agencies

Table 12 displays the list of funding agencies who invested in drug discovery research in India. CSIR has the maximum output with 723 records (14.8%) followed by University Grants Commission (UGC) with 568 records (11.6%) and Department of Science and Technology (DST) with 563 (11.5%) records and other major institutes are DBT, ICMR, NIH, University of Delhi, etc.

Table 12 List of funding agencies in drug discovery research in India

Funding Agencies	records	% of 4850
COUNCIL OF SCIENTIFIC INDUSTRIAL RESEARCH CSIR INDIA	723	14.880
UNIVERSITY GRANTS COMMISSION INDIA	568	11.690
DEPARTMENT OF SCIENCE TECHNOLOGY INDIA	563	11.587
DEPARTMENT OF BIOTECHNOLOGY DBT INDIA	386	7.944
INDIAN COUNCIL OF MEDICAL RESEARCH ICMR	225	4.631
NATIONAL INSTITUTES OF HEALTH NIH USA	111	2.284
UNITED STATES DEPARTMENT OF HEALTH HUMAN SERVICES	111	2.284
DEPARTMENT OF BIOTECHNOLOGY	40	0.823
NATIONAL NATURAL SCIENCE FOUNDATION OF CHINA	32	0.659
UNIVERSITY OF DELHI	29	0.597
SCIENCE ENGINEERING RESEARCH BOARD SERB INDIA	27	0.556
DST SERB	23	0.473
EUROPEAN UNION EU	23	0.473
WELLCOME TRUST	21	0.432
DEPARTMENT OF ATOMIC ENERGY DAE	20	0.412
KING SAUD UNIVERSITY	19	0.391
NATIONAL SCIENCE FOUNDATION NSF	19	0.391
NIH NATIONAL CANCER INSTITUTE NCI	17	0.350
NIH NATIONAL INSTITUTE OF ALLERGY INFECTIOUS DISEASES NIAID	14	0.288
BOARD OF RESEARCH IN NUCLEAR SCIENCES BRNS	13	0.268
MINISTRY OF HUMAN RESOURCE DEVELOPMENT MHRD GOVERNMENT OF INDIA	13	0.268
DST PURSE	12	0.247
GATES FOUNDATION	12	0.247
GOVERNMENT OF INDIA	12	0.247
SCIENCE AND ENGINEERING RESEARCH BOARD	12	0.247
(2527 Funding Agencies value(s) outside display options.)		
(1888 records (38.856%) do not contain data in the field being analyzed.)		

Keyword dynamics

Table 13 displays year-wise distribution and occurrence of the top ten keywords. The keyword 'Discovery' first appeared once in 1996 and continued till 2020 (1106 times). The keyword 'Drug Discovery' first appeared once in 1997 and 943 times in 2020. It was not used from 1991 to 1996. The keyword 'Derivatives' first appeared once in 1996 and continued till 2020 (589 times).

Table 13 year-wise distribution of top ten keyword dynamics

Year	DISCOVERY	DRUG DISCOVERY	DERIVATIVES	INHIBITORS	DESIGN	IN-VITRO	IDENTIFICATION	BIOLOGICAL EVALUATION	DOCKING	NATURAL- PRODUCTS
1991	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	1	0	0	0	0	0
1996	1	0	1	0	1	0	0	0	0	0
1997	2	1	1	0	2	0	0	0	0	0
1998	2	4	2	1	2	0	0	0	0	0
1999	2	5	2	1	2	0	1	0	0	0
2000	2	6	2	1	2	0	1	0	0	0
2001	5	9	3	2	3	0	1	0	0	1
2002	5	11	3	2	5	0	2	0	0	1
2003	5	12	4	3	5	3	2	0	0	1
2004	12	17	5	4	7	4	6	0	1	1
2005	18	24	10	6	9	5	8	0	2	2
2006	31	31	10	7	9	9	12	1	3	4
2007	39	42	12	9	11	12	15	1	8	9
2008	58	60	19	17	14	22	24	5	13	10
2009	84	82	32	23	20	29	32	6	19	13
2010	103	102	40	36	25	36	40	9	20	18
2011	143	137	59	52	34	47	52	15	25	25
2012	188	198	87	72	56	60	60	19	36	37
2013	264	264	127	115	84	94	83	36	55	51
2014	360	340	173	166	117	118	114	52	73	71
2015	465	420	220	218	158	155	132	68	102	87
2016	575	534	284	275	205	200	156	98	132	122
2017	705	665	360	343	264	263	200	155	178	158
2018	869	815	449	425	343	319	235	220	220	201
2019	1032	893	542	495	424	370	296	275	271	219
2020	1106	943	589	528	466	399	317	306	290	242

Source impact using h-index

Table 15 shows the highly productive sources based on its h-index. The journal 'EUROPEAN JOURNAL OF MEDICINAL CHEMISTRY' has the maximum h-index of 39 (206 publications, 6526 citations). The journal 'BIOORGANIC & MEDICINAL CHEMISTRY

LETTERS 'has got the second highest h-index 29 (134 records, 2727 citations) followed by the journal 'JOURNAL OF MEDICINAL CHEMISTRY' and 'JOURNAL OF BIOMOLECULAR STRUCTURE & DYNAMICS' with the h-index of 25 (58 records, 2019 citations) & 24 (73 records, 2162 citations) respectively. There are 12 journals with the h-index between 10-19.

Table 15 highly productive sources based on h-index

Source	h_index	g_index	m_index	TC	NP	PY_start
EUROPEAN JOURNAL OF MEDICINAL CHEMISTRY	39	70	2.29	6526	206	2004
BIOORGANIC & MEDICINAL CHEMISTRY LETTERS	29	43	1.26	2727	134	1998
JOURNAL OF MEDICINAL CHEMISTRY	25	44	1.47	2019	58	2004
BIOORGANIC & MEDICINAL CHEMISTRY	24	45	1.26	2162	73	2002
RSC ADVANCES	19	35	1.9	1469	85	2011
PLOS ONE	18	26	1.5	940	66	2009
JOURNAL OF BIOMOLECULAR STRUCTURE & DYNAMICS	17	24		1014	149	2004
CURRENT TOPICS IN MEDICINAL CHEMISTRY	16	28	1.45	986	96	2010
MEDICINAL CHEMISTRY RESEARCH	15	24	0.75	940	125	2001
CHEMICAL BIOLOGY & DRUG DESIGN	15	24		723	57	2006
MINI-REVIEWS IN MEDICINAL CHEMISTRY	13	24	0.92	650	50	2007
SCIENTIFIC REPORTS	13	19	1.85	492	49	2014
JOURNAL OF MOLECULAR GRAPHICS & MODELLING	13	20	0.8125	504	47	2005
EXPERT OPINION ON DRUG DISCOVERY	13	20	0.86	495	42	2006
BIOORGANIC CHEMISTRY	12	23	1.33	627	61	2012
CURRENT SCIENCE	11	27	0.42	779	42	1995
COMBINATORIAL CHEMISTRY & HIGH THROUGHPUT SCREENING	9	19	0.45	447	51	2001
CHEMISTRYSELECT	8	11	1.6	200	45	2016
LETTERS IN DRUG DESIGN & DISCOVERY	7	9	0.58	159	59	2009
CURRENT COMPUTER-AIDED DRUG DESIGN	7	10	0.46	160	44	2006

Network visualization of Citations of Sources



Figure 6 displays the network visualization of highly productive journals based on the maximum citations. European Journal of Medicinal Chemistry tops in the list.

Conclusion

Drug discovery research in India has seen the rapid growth and a total of 4850 records were found during the study period from 1991 to 2020. Kumar, A. is the highly productive author in terms of publications (123) and h-index (20) as well. Pandey, A. has the maximum GCS (2306). CSIR has produced the maximum research output of 216 records (3374 GCS) and other major institutes who contributed in the study area are IIT, CDRI, IISc & IICT. India collaborated more with USA and produced more number of publications (485) and other countries are Saudi Arabia, Germany, China, Korea, UK & Italy. This shows broader perspective of research and development in India. Our findings show that Government of India has been very keen in investing in drug discovery research as institutes such as CSIR, DST, DBT, CDRI, IISc & IIT have produced more research publications in DD research.

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