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A bibliometric evaluation of organic chemistry research in India

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Organic chemistry as a research area contributes to more than one percent of world publication output. The present paper attempts to draw a detailed, in-depth bibliometric analysis of organic chemistry research activity during the last decade (2004 to 2013) with special emphasis on the Indian contribution. The Indian output is compared with that of world's leading countries using exergy, an indicator which combines quantity and quality of publications. A three-dimensional approach combining quantity, quality and consistency is used for analysing the performance of various institutions and authors. It is found that organic chemistry research activity in India during 2004-2013 is equal to the world average and its growth pattern is positive and similar to the worldwide research growth. India ranks at the 9th position based on the Exergy(X), the performance indicator while USA, Germany and China occupy first, second and third positions.Among others, the most productive organisations and authors are also identified using h-index and z-index. The paper identifies countries, international organisations and journals that cite the Indian contributions in the field.

Keywords: Bibliometrics; Activity index; Citation; Indicators; Three-dimensional evaluation; Collaboration; Organic chemistry; India

Introduction

Bibliometric services are carried out for studying the growth pattern, progress and spread of any discipline or area of research and also for identifying centres of excellence, most potential authors, countries etc. Bibliometrics is now an accepted analytical tool to monitor and analyse the research performance of institutions, individuals etc. for diverse purposes and includes quantitative and qualitative analysis of research papers. New areas of research are fast emerging and bibliometric analysis of different disciplines is also gaining momentum. Organic chemistry research is one such area which has grown exponentially over the recent years.

Organic chemistry is the chemistry of carbon compounds. The term organic literally means "derived from living organisms". Originally, the science of organic chemistry was the study of compounds extracted from living organisms and their natural products. Compounds such as sugar, urea, starch, waxes and plant oils were considered "organic"[1]. Every living organism is made of organic chemicals. The proteins that make up our hair, skin and muscles, the DNA that controls our genetic heritage, the foods that nourish us, and the medicines that heal us are all organic chemicals.[2]

Currently, organic chemistry is considered as a major and crucial area of research in India and, the Government funded research agencies and institutions of higher learning involved in teaching and research, academic institutions, universities, and private-funded R&D establishments are all fully equipped with large organic chemistry laboratories. Organic chemistry research in India accounts for more than 1% of world research output.

Review of literature

Quantitative studies on the emergence of organic chemistry research in India during 1907-1926 and scientometric assessment of Indian organic chemistry research during 1970s and 1980s, both based on Chemical Abstracts database were undertaken by Guav[3] and Karki & Garg[4] respectively. The studies indicate that India has a long history of chemical investigations and that chemistry is the most popular discipline followed by mathematics and physics. The

study by Karki & Garg shows that organic chemistry research has shown signs of improvement by the end of 1980. Another study by Nagpal & Pant[5] on cross-national assessment of specializations in chemistry, also shows that organic chemistry is a strong area of research in the chemical sciences in India.

Karki, Garg and Sharma explored the activity and growth of organic chemistry research in India during 1971-1989 as reported in Chemical Abstracts database and observed that India's research effort in organic chemistry matches precisely with that of the world's average during 1971-1989[6]. During the period of study, Indian organic chemists published 9244 papers i.e. about 2.6% of the world output in Chemistry. The change in emphasis for different sub-fields of organic chemistry are almost similar for India and the world.

A bibliometric analysis of alkaloid chemistry research in India during 1979-1987 by Karki & Garg reveals that the activity index of Indian alkaloid research increased significantly, reaching its peak in 1981 - 3.5% of the world output. Central Drug Research Institute was found to be the most productive lab in alkaloid research with about 16% of the total Indian research output[7].

Analysing the research contributions of the faculty members of Pune University department of chemistry, Nagarkar[8] found that most papers published in peer-reviewed international journals have high impact factor. The main area of research of the department is physical chemistry and most cited articles were published in the *Journal of Physical Chemistry A*.

Mapping of green chemistry research in India during the period 1999-2013 by Ranganathan & Balasubramani illustrate that 2012 was the year of highest output. The degree of collaboration in green chemistry was seen to be 0.95[9].

In their study on citation analysis of top research papers in chemistry as reflected in ScienceDirect during the period 2004-2008, with specific reference to India, Maharana, Majhi and Sethi observed that out of 450 top research papers in chemistry indexed in ScienceDirect during the period, 36 were contributed by Indian researchers. Twenty five percent of Indian papers received citations between 10 and 25 times. In the ranking of contributing countries, India was found to secure the third position after the USA and China[10].

Lalitha Kumari analysed the Indian research output and impact in synthetic organic chemistry (SOC) during the period 1998-2004 drawing data from the selected synthetic organic chemistry journals. It was observed that for Indian publications, absolute citation Impact (ACI) and relative citation impact (RCI) are less than world average and that China out-performed India in these during the period of study[11].

Varaprasad and Ramesh explored the activity and growth of Indian chemical science research during 1987-2007. It was observed that the average value of the activity index for India during 1987-2007 was 100.9, which indicated that India's research effort in chemical science is slightly higher than the world average. Seventy percent of the highly productive institutions have given importance to both organic and inorganic chemistry and 60% to applied chemistry. In organic chemistry, Indian Institute of Chemical Technology was found to be the most dynamic institute followed by National Chemical Laboratory and University of Delhi[12].

The present study is an analysis of the organic chemistry data from India during the period 2004-2013 and the evaluation also includes application of new indices that have not been used in previous studies reviewed here with regard to analysis of chemistry research output.

Objectives of the study

- To compare world output with India's output in organic chemistry research and to determine India's position among the major organic chemistry publishing countries of the world;
- To identify the most productive organic chemistry research institutions and centres of excellence in India based on quantity, quality and consistency indicators;
- To distinguish the leading Indian authors in organic chemistry research;
- To list the preferred journals of Indian researchers for publishing papers in the field of organic chemistry;
- To depict the level of collaboration at the international level; and
- To study the worldwide citations to Indian papers.

Methodology

Web of Science, a versatile database from Thomson Reuters has been used as the source of data. Only journal articles and review articles were considered for the analysis.

The database was searched on the following search query:

> **Topic** =(Organic Chemistry OR Organic Compounds OR Organic Materials OR Organic Reactions OR Hydrocarbons OR Organometallics OR Aliphatic Compounds OR Fatty Compounds OR carboxylic acids OR Aromatic compounds OR Heterocyclic Compounds OR Atomic bonding OR Carbocyclic compounds) NOT **TOPIC**: (Inorganic) AND **Research Area** =Chemistry
>
> **Timespan:** 2004-2013.

This resultant data was further analysed to find out year-wise and country-wise distribution of organic chemistry research publications in the world during the period of study. A total of 171581 records were retrieved which was further refined for Country = India to extract the Indian output in the topic. The search yielded 10267 records by the Indian scientists in the field of organic chemistry for the 10-year period of 2004-2013. The records were downloaded and bibliometrically analysed on various parameters using BibExcel and Microsoft Excel. The cited documents of the result set were downloaded and anaysed to see the countries, organisations and journals that are citing the Indian organic chemistry research papers.

Analysis

The study reveals that India's publication output in organic chemistry accounts for nearly 1.13% of total World STM output and it shows an increasing trend from 0.98% in 2004 to 1.13% in 2013.

Country-wise distribution of papers

United States with 31832 papers is the leading contributor followed by China with 30795 papers. China and USA together account for 36% of world organic chemistry research publications. In the year 2010, China overtook USA as the most prolific contributor to the world organic chemistry research (Table 1). India ranks 6th among the countries publishing organic chemistry papers.

In addition to the number of papers (P) as shown in Table 1, we also considered the citations (C) to the papers during this period. The quality or impact is defined as $i = C/P$, as the ratio of total citations C to total papers published P. A performance indicator combining both quantity and quality called Exergy(X) introduced by Prathap was computed as $X=iC$ and this was used to rank the highly publishing countries in organic chemistry[13]. Exergy(X) can be interpreted to signify performance, as a hyperbolic product of quality (impact) and quantity.

Table 2 shows the country ranking based on Exergy, the single number scalar indicator of performance, considering both quantity and quality. China occupies the 3rd rank after USA and Germany whereas India stands on the 9th position in terms of performance (Exergy). When we look at the impact(i) of the publications, the highest impact is for

Table 1—Papers in organic chemistry published annually by leading countries

	Country	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004
1.	USA	3738	3628	3439	3312	3208	3063	2893	2929	2900	2740
2.	Peoples R China	5074	4752	4135	3534	3178	2753	2316	1941	1685	1449
3.	Japan	1462	1430	1493	1288	1378	1400	1389	1303	1320	1329
4.	Germany	1570	1652	1573	1457	1332	1250	1243	1204	1135	1094
5.	France	1203	1138	1123	1144	1027	989	988	1008	845	830
6.	India	1476	1400	1300	1040	992	957	886	870	705	659
7.	Spain	1103	1127	1102	1008	986	948	960	860	809	767
8.	Italy	822	756	739	738	739	711	723	724	683	619
9.	England	851	812	799	736	696	704	680	688	611	669
10.	Russia	637	590	598	551	625	602	580	503	491	586

publications from USA, followed by England and Germany. China and India rank 8th and 9th respectively in terms of impact.

Research activity in India

World Output vs. Indian Output

The analysis indicates that the total number of publications by Indian researchers in organic chemistry during 2003-2014 are 10267 which is around 5.98% of the total world output. In Fig. 1, from the linear trend lines, it is observed that the world literature output in organic chemistry during the period of study (2004-13) is showing a very consistent growth and similarly, the Indian output is also consistently growing in line with the world growth.

India's share in world organic chemistry research

During the period of study, number of Indian organic chemistry publications increased consistently every year. Indian share of world organic chemistry production has increased from 4.97% in 2004 to 6.79% in 2013. Fig. 2 shows that the Indian output is an average of 5.98% of the world contributions during 2004-2013. However, during 2006 to 2010, did not increase much in terms of percentage of the world share. We can see an enormous hike in publication output in the International Year of Chemistry (2011), and the growing trend is continuing in terms of percentage share of world research.

Activity Index

A comparison of India's contributions with the world contributions was carried out using Relative Activity Index (RAI), first suggested by Frame[14] and subsequently made use of by bibliometricians like Schubert, Braun, Garg, Padhi, Varaprasad and Ramesh[12,14-16]. The Relative Activity Index indicates whether a unit is more or less active in their chosen sub-domains than the rest of the world.

It is defined as:

RAI = Given field's share in the country's publication output / Given field's share in the worlds publication output.

Mathematically,

where n_{ij} is the Indian output of papers in a particular field; n_{io} is the total Indian output in all fields; n_{oj} is the world output of papers in a particular field; and n_{oo} is the total world output in all fields.

RAI = 100 indicates that the country's research effort in the given field corresponds precisely to the world's average. RAI >100 reflects higher activity than the world's average, and RAI <100 indicates lower than average effort dedicated to the field under study. In this paper, using the above formula, RAI for India and the world is calculated for different years to see the variation in the level of India's performance during the period of study. Here RAI is worked out for each year as:

{Indian output in Organic Chemistry /total Indian output }/{World output in Organic Chemistry /total world output }×100

Data in Table 3 indicates that India's research effort in organic chemistry was less than that of world average for the years 2004 to 2010, crossed the world average in 2011 and, shows a steady increase after that reaching 113.44 in 2013. The Average RAI for India 98.54 during 2004-2013 is an indication than

Table 2—Top 10 Countries publishing in Organic chemistry Research ranked according to exergy indicator(*X*)

	Country	% of World Output	Impact (*i*)	Exergy (*X*)
1.	USA	18.55	25.14	20118977
2.	Germany	7.86	22.91	7082163
3.	Peoples R China	17.95	15.15	7070895
4.	Japan	8.03	18.70	4819604
5.	England	4.22	24.38	4304894
6.	France	5.99	18.88	3665990
7.	Spain	5.63	19.44	3655489
8.	Italy	4.22	18.20	2401719
9.	India	5.98	11.82	1435162
10.	Russia	3.34	7.03	283576

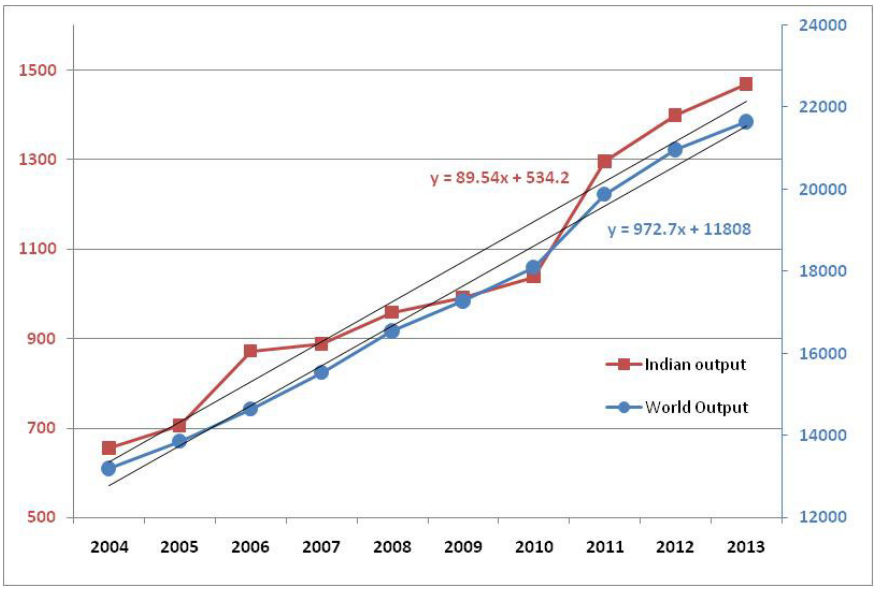

Fig. 1—Growth of organic chemistry research in world and in India

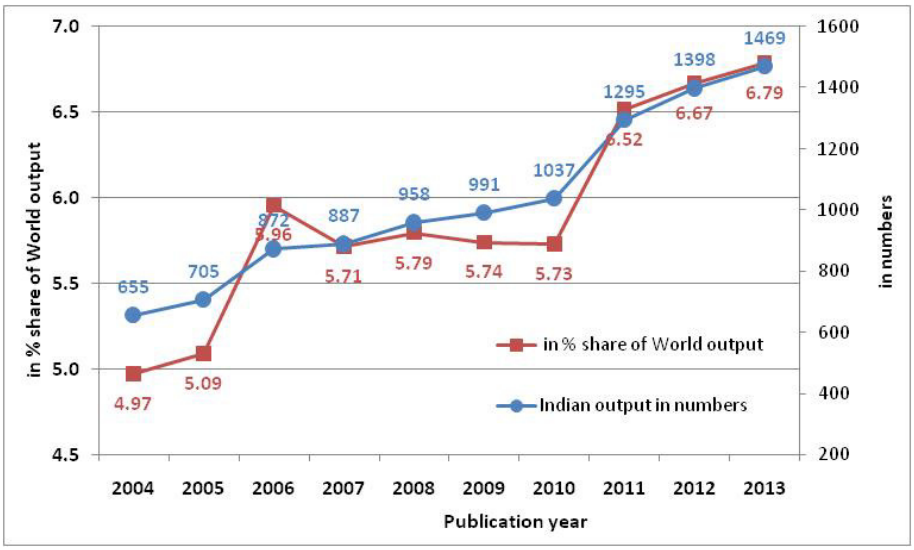

Fig. 2—Indian Organic Chemistry research as percentage share of world output

Table 3—Activity Index of Indian organic chemistry research during 2004-2013

Year	Indian output	World Output	Activity Index
2004	655	13181	83.04
2005	705	13853	85.05
2006	872	14643	99.52
2007	887	15526	95.47
2008	958	16534	96.83
2009	991	17267	95.91
2010	1037	18095	95.77
2011	1295	19872	108.90
2012	1398	20964	111.44
2013	1469	21641	113.44
Total	10267	171576	98.54

India's level of performance in organic chemistry is healthy.

Major institutions

The 3-D evaluation recently proposed by Prathap is used to rank the institutions in organic chemistry research in India[17]. The quantity (productivity in terms of number of papers published) and quality (specific impact defined as citations per paper) are complemented with a third dimension, called consistency η. This enables a 3-D evaluation of the information production process. As observed earlier, the Exergy indicator($X = iC = i^2P$, a robust second-order performance indicator is arguably a better proxy for performance[18]. Apart from X, an additional indicator $E = \Sigma c_k^2$ *where* $k = 1$ *to* P, also appears as a second-order indicator. The simple ratio of X to E can be viewed as the third component of performance, namely, the consistency term $\eta = X/E$. Perfect consistency ($\eta = 1$, i.e., when $X=E$) is a case of absolutely uniform performance; that is, all papers in the set have the same number of citations, $c_k = c$. The greater the skew, the larger is the concentration of the best work in very few papers of extraordinary impact. The inverse of consistency thus becomes a measure of concentration. Table 4 presents India's highly productive ten institutions in organic chemistry.

Thus, for a complete 3-D evaluation of publication activity, the three primary components of quantity P, quality i and consistency η can be used together, yielding a Zynergy indicator and a z-index computed $Z = \eta X = \eta^2 E$ and $z = Z^{1/3}$ respectively[17]. Table 4 shows the leading 10 organisations in organic chemistry research ranked according to the default quantity parameter P. Council of Scientific and Industrial Research (CSIR) occupies the top position with 2321 papers followed by Indian Institute of Technology (IIT) with 1365 publications. Fig. 3 summarises the performance of these institutions in an h-z 2-D map.

The h-index is defined as the number of publications (h), attributed to the analyzed unit during the analyzed time span, which have at least h citations. H-index is very easy to count by ordering the citation sequence in a monotonically decreasing fashion[19]. However, h-index gives positive bias to older articles, since these have had more time to be cited. In a publication set, highly cited articles are concentrated in a small number and h-index does not indicate the balanced quality of the total unit from total publications. Prathap[13,18] argues that when such high skews are present, the product $X = iC = i^2P$, a robust second-order indicator is a better proxy for performance than C itself and the z-index is a more meaningful proxy measure of performance.

From Fig. 3, it is observed that Council of Scientific and Industrial Research (CSIR) has the highest h-index and z-index followed by IIT and IISc.

Leading authors in organic chemistry research

Usually, bibliometric studies identify prolific authors based on the number of papers published by an author. This zeroth order ranking may not correctly identify leading authors. For identifying leading

Table 4—Top 10 organisations publishing organic chemistry research in India ranked to quantity parameter P

	Organisation	Documents (P)	Impact $i = C/P$	h-index	$\eta = X/E$	$z = (\eta X)^{(1/3)}$
1.	CSIR	2321	17.35	73	0.141	46.138
2.	IITs	1365	16.33	60	0.217	42.935
3.	IISc	485	18.38	44	0.266	35.185
4.	IACS, Kolkata	393	16.08	39	0.355	33.039
5.	BARC	249	9.05	20	0.289	18.059
6.	Univ. Delhi	243	11.01	26	0.322	21.168
7.	Univ. Hyderabad	234	19.4	34	0.224	27.006
8.	Jadavpur Univ.	230	14.65	30	0.376	26.490
9.	JNCASR	201	30.94	36	0.069	23.728
10.	BHU	158	8.91	20	0.307	15.674

[CSIR - Council of Scientific and Industrial Research labs; IITs – All 17 Indian Institute of Technology; IISc – Indian Institute of Science; IACS – Indian Association for the Cultivation of Science; BARC – Bhabha Atomic Research Centre; JNCASR – Jawaharlal Nehru Centre for Advanced Scientific Research; BHU – Banaras Hindu University]

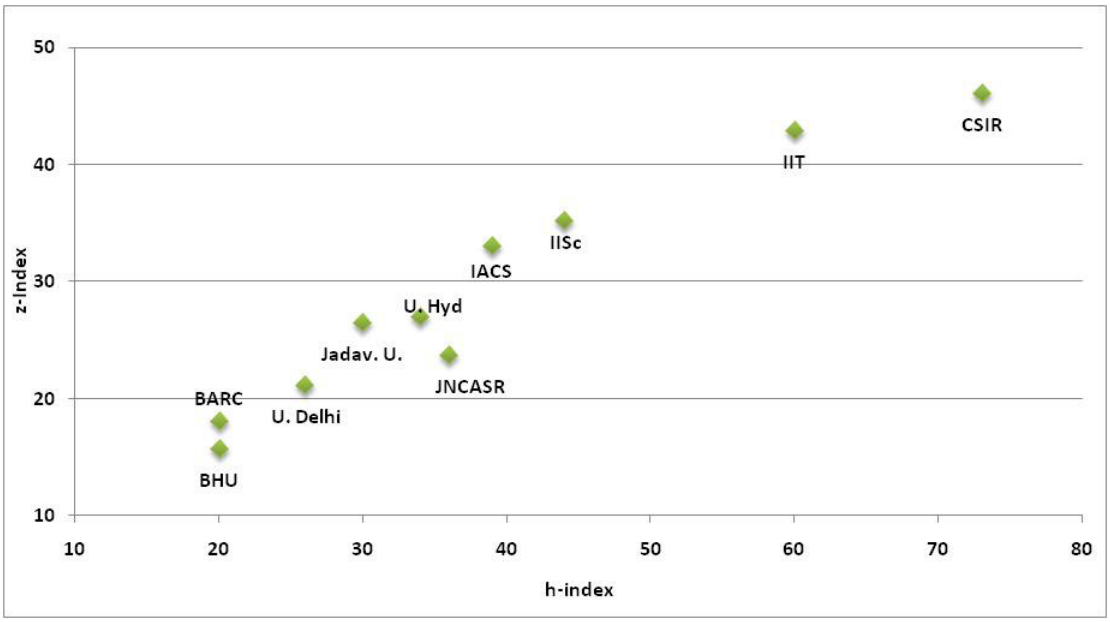

Fig. 3—z-h map of Indian leading organisations in organic chemistry research

Table 5—Leading Indian authors publishing in organic chemistry ranked according to z-index

	Author	Documents (P)	Impact (i)	Consistency (η)	z-index
1.	Vaidhyanathan R, JNCASR	2	754.500	0.502	82.988
2.	Praveen VK, CSIR-NIIST	6	171.833	0.524	45.269
3.	Ajayaghosh A, CSIR-NIIST	17	106.235	0.436	43.740
4.	Nair V, CSIR-NIIST	30	51.833	0.336	30.025
5.	Bharadwaj PK, IIT-Kanpur	43	37.814	0.427	29.714
6.	Ranu BC, IACS-Kolkata	56	29.839	0.524	29.667
7.	Pal T, IIT-Kharagur	17	56.765	0.422	28.483
8.	Nangia A, Univ Hyderabad	34	36.824	0.497	28.406
9.	Basavaiah D, Univ. Hyderabad	8	89.875	0.321	27.465
10.	Pandey S, IIT- New Delhi	13	72.154	0.300	27.271
11.	Mahata P, IISc	20	42.000	0.551	26.889
12.	Rao CNR, JNCASR	51	64.294	0.080	25.639
13.	Desiraju GR, IISc	30	31.033	0.578	25.559
14.	Bhattacharya S, IISc	28	30.214	0.647	25.480
15.	Sarkar M, IIT-Kanpur	8	76.750	0.347	25.388
16.	Chakraborti AK, NIPER	32	32.281	0.479	25.188
17.	Yadav JS, CSIR-IICT	102	16.108	0.508	23.786
18.	Singh VK, IIT-Kanpur	18	38.389	0.434	22.587
19.	Reddy BVS, CSIR-IICT	74	17.108	0.509	22.251
20.	Natarajan S, IISc	66	48.955	0.066	21.900

authors, we also need to consider impact and consistency.

Table 5 presents the list of 20 Indian authors in the field of organic chemistry ranked according to

z-index. It shows that Vaidhyanathan R, JNCASR tops the list with the z-index 82.988 followed by Praveen VK, CSIR-NIIST and Ajayaghosh A, CSIR-NIIST. However, if one where to look for prolific authors, JS yadav and BVS Reddy of CSIR-IICT get ranked first and second respectively followed by S. Natarjan, BC Ranu and CNR Rao as can be seen from their number of papers in Table 5.

Countries, high impact journals and preferred journals by Indian scientists

The organic chemistry research articles from India are published in journals of 40 different countries. Only 15% of Indian output is published in India (Table 6) where as 27% and 26% of Indian output were published in England and USA respectively.

Nishy et al observed that the best research in chemistry from India is increasingly appearing in international journals[20]. Many papers were published in high impact factor journals like *Chemical Reviews, Nature Chemistry* etc. Table 7 shows the list of high impact journals where Indian organic chemists published their research according to Journal Citation Report(JCR)-2013. However, more number of papers were published in journals with average impact factor and Table 8 shows such most preferred journals by Indian organic chemists. It is found that the journal *Tetrahedron Letters* with 602 papers is the most preferred journal of Indian chemists for publishing organic chemistry papers. Among the Indian journals, *Indian Journal of Chemistry Section B-Organic Chemistry Including Medicinal Chemistry* topped the list with 313 papers.

International collaboration

Collaboration gives more visibility for the research output. An analysis of authorship pattern of Indian organic chemists reveals the tendency among Indian researchers to collaborate with scientists from other countries. The Indian collaboration during the period is mainly with USA (375 papers) which is about 3.7% followed by Germany (214 papers), Japan (158

Table 6—Countries where Indian organic chemistry research are published

Publishing Country	Papers
1. England	2816
2. USA	2626
3. India	1512
4. Netherlands	1394
5. Germany	879
6. Switzerland	364
7. U Arab Emirates	116
8. Bulgaria	87
9. Japan	80
Next 31 countries	393
Total	10267

Table 7—High impact factor journals where Indian organic chemistry research published

Journal	Impact Factor	Papers
1. Chemical Reviews	41.298	7
2. Chemical Society Reviews	24.892	18
3. Nature Chemistry	21.757	3
4. Accounts of Chemical Research	20.833	21
5. Advanced Materials	14.829	4
6. Angewandte Chemie-International Edition	13.734	29
7. ACS Nano	12.062	5
8. Energy & Environmental Science	11.653	6
9. Coordination Chemistry Reviews	11.016	11
10. Journal of the American Chemical Society	10.677	39

Table 8—Leading journals ranked according to the number of Indian papers

	Journals	Place of Publication	Impact Factor	Indian output	
				in numbers	%of Journal output
1.	*Tetrahedron Letters*	England	2.40	602	18.17
2.	*Indian Journal of Chemistry Section B*	India	0.69	313	87.43
3.	*Asian Journal of Chemistry*	India	0.25	294	32.10
4.	*Synthetic Communications*	USA	1.06	236	25.03
5.	*Journal of The Indian Chemical Society*	India	0.25	226	95.76
6.	*Indian Journal of Heterocyclic Chemistry*	India	0.17	218	96.46
7.	*Tetrahedron*	England	2.80	214	7.50
8.	*Crystal Growth & Design*	USA	4.69	186	11.20
9.	*Journal of Organic Chemistry*	USA	4.56	172	5.04
10.	*Synlett*		2.66	154	10.38
11.	*Journal of Chemical Sciences*	India	0.00	140	76.50
12.	*RSC Advances*	England	2.56	134	18.06
13.	*European Journal of Organic Chemistry*	Germany	3.344	120	6.48
14.	*Journal of Heterocyclic Chemistry*	USA	1.224	116	21.25
15.	*Bioorganic & Medicinal Chemistry Letters*	England	2.338	116	11.39

papers), England (134), France (122), South Korea(115), Spain(114) and Taiwan and Italy with 71 papers each. It could be observed that India has benefited from international collaboration in attracting more citations. It is evident from Table 9 that the collaborative papers have much more impact in terms of citation per paper. The degree of international collaboration in organic chemistry research is steadily increasing and is highest in the year 2013 with 283 publications.

Citing of Indian papers

Indian organic chemistry papers are cited mainly by authors from China (23.42%), USA (9.37%), Iran (4.65%), Germany (4.62%) and Japan (4.5%) etc. It is interesting to note that even though India does not have any collaborative research in organic chemistry with China, Chinese authors are found to cite Indian organic chemistry research to the extent of 23.42%. Table 10 shows the major organisations and the journals which cite Indian organic chemistry research.

Conclusion

On the basis of the bibliometric study, it can be concluded that organic chemistry research activity in India during 2004-2013 is equal to the world average and its growth pattern is positive and similar to the worldwide research growth. India ranks at the 9th position based on the Exergy(X), the performance indicator while USA, Germany and China occupy first, second and third positions.

The detailed 3-Dimensional bibliometric analysis from quantity, quality, and consistency parameters has been done on Indian output, which is around 6% of World output, to identify the leading organisations, authors and also the preferred journals by Indian researchers in organic chemistry research. CSIR is found to be the most contributing organisation followed by IIT and IISc. The study reveals the preference of Indian authors to publish in international journals especially *Tetrahedron Letters*, *Synthetic Communications* and *Tetrahedron*. Around 15% publications are in Indian chemistry journals. Articles from foreign journals like *Tetrahedron Letters*, *Tetrahedron*, *Journal of Organic Chemistry*, *Crystengcomm*, *Chemical Communications*, *RSC Advances*, *Crystal Growth Design*, etc. are highly cited by the Indian authors and only 1.2% articles are cited from Indian Journals. Around 16% of Indian research output is with international collaborations with countries like, USA, Germany, Japan, England, etc. and such papers are having 1.5 times more impact than papers without collaboration in organic chemistry. Indian research papers are cited mainly by Chinese authors from Chinese Academy of Sciences,

Table 9—Collaboration in organic chemistry research

Year	Degree of collaboration	India (without collaboration)			India (with Int. Collaboration)		
		Papers	Impact	Exergy	Papers	Impact	Exergy
2004	15.27	555	21.93	266819	100	30.99	96038
2005	14.89	600	21.01	264726	105	28.46	85030
2006	14.56	745	17.75	234730	127	25.28	81135
2007	14.54	758	16.08	195876	129	21.57	59996
2008	13.36	830	13.74	156771	128	16.78	36046
2009	15.64	836	11.45	109528	155	17.86	49467
2010	14.27	889	9.59	81750	148	13.24	25957
2011	17.07	1074	7.18	55420	221	13.34	39324
2012	19.03	1132	4.93	27535	266	7.22	13859
2013	19.26	1186	1.75	3634	283	2.88	2353
Total	16.19	8605	11.05	1050046	1662	14.83	365301

Table 10—Countries, Organisations and journals citing Indian organic chemistry papers

Countries	Int. Organisations	Journals
Peoples R China (23.42%)	CAS (10.78%)	*Tetrahedron Letters (3.40%)*
USA (9.37%)	CNRS (7.08%)	*Tetrahedron (2.06%)*
Iran (4.65%)	CSIC (2.58%)	*Journal of Organic Chemistry (1.85%)*
Germany (4.62%)	IAU (2.56%)	*CrystEngComm (1.81%)*
Japan (4.50%)	Nanjing U (2.46%)	*Chemical Communications (1.77%)*
Spain (3.73%)	RAS (2.25%)	*RSC Advances (1.75%)*
France (3.50%)	Nankai U (2.08%)	*Crystal Growth Design (1.74%)*
South Korea (2.90%)	Jilin U (2.04%)	*Dalton Transactions (1.68%)*
England (2.69%)	California U (1.96%)	*Chemistry A European Journal (1.64%)*
Italy (2.57%)	Z U (1.95%)	*Organic Letters (1.49%)*

(CAS - Chinese Academy of Sciences; CNRS - Centre National De La Recherche Scientifique**;** CSIC - Consejo Superior De Investigaciones Cientificas; IAU - Islamic Azad Univ; RAS -Russian Academy of Sciences; ZU - Zhejiang University)

Nanjing Univ., Nankai Univ. and Jilin Univ., etc. even though India does not have any collaborative research with China in organic chemistry. Indian Papers receive citations from many foreign journals.

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