Annals of Library and Information Studies
Vol. 61, June 2014, pp. 85-92

A bibliometric analysis of publications of the Chemistry Department, University of Pune, India, 1999-2012

Shubhada Nagarkar

Assistant Professor, Department of Library and Information Science, University of Pune, Pune, Maharashtra,
Email: shubha@unipune.ac.in

Received: 6 December 2013; revised: 30 April 2014; accepted: 11 May 2014

The bibliometric parameters including number of papers, number of citations received, institutional collaborations, productivity of journals, subject categories and authorship pattern have been used to carry out the analysis of the research contributions made by the faculty members of the Department of Chemistry at University of Pune. The data set was collected from the Web of Science (WoS) database for the period of about 14 years (1999-2012). The data reveals that thirty faculty members have published 811 papers in 258 journals with 8948 citations. Most of the papers are published in peer-reviewed international journals having high impact factor. These are core journals in the field of chemistry being published in the countries like USA, UK and Germany, etc. The study reveals that there is a continuous growth in publications. About 30% of the papers were published during 2010-2012. The average number of citations received per paper is 11.03. The highest number of citations (905) were received for 41 papers published in the Journal of Physical Chemistry A. This study indicates that majority of the papers published are in the area of physical chemistry. Authorship pattern indicates that highest number of citations are received for papers written by four authors in collaboration.

Keywords: Bibliometrics; Citation analysis; Chemistry; University of Pune; Network analysis

Introduction

The Department of Chemistry, University of Pune is rated as one of the best in the country for its teaching and research activities. It has been selected as the Centre for Advanced Studies in chemistry by the University Grants Commission, India since 1998. The Department has a close collaboration with National Chemical Laboratory, Pune; which is one of the Council of Scientific and Industrial Research (CSIR) laboratories in India. The department has four specializations – physical, organic, inorganic and biochemistry. The present study focuses on the citation analysis of the research contributions made by the faculty members of the Department during the period 1999-2012.

Citation analysis is used as an indicator of the impact, influence or quality of a scholarly work[1]. It is most often used for measuring the quality of research and facilitating collection development in libraries[2-6] as well as for judging scientific research output at local, national and international levels. Citation counts help to assess the impact of individual research scientists as well as contribution of the organization as a whole. Apart from number of papers and citations received, various other parameters are used to measure the research output viz., impact factor of the journal, author h-index, international collaborations, etc.

Citation databases such as Web of Science, Scopus and Google Scholar are used to obtain the citation data. These databases are enriched with advanced features to enable detailed citation analysis along with h-index value[7-8]. Apart from various indicator measures, various data visualization tools (CiteSpace (http://cluster.cis.drexel.edu/~cchen/citespace/), VOSviewer (www.vosviewer.com), Pajek (http://vlado.fmf.uni-lj.si/pub/networks/pajek) etc.) are also being used for visualizing bibliographic coupling of authors, institutes and keywords. Citation visualization tool HistCite launched by Eugene Garfield, identifies the most cited authors within a field, and reconstruct the history and development of a research field[9-11].

Review of literature

Various citation analysis studies have been carried out for measuring the individual research and organizational contributions[12-17].

Torres and others have studied the contributions by 864 researchers from 50 Health Science Departments of the University of Navarra (Spain). They compared the difference in the number of citations provided by WoS and Scopus in the context of evaluating a single university. They ranked top 50 researchers and the departments and found that in both the databases, there is no major difference in the first position[18]. Another study based on bibliometric analysis was conducted by Molinari and Molinari for ranking scientific institutions. They named their method as "Impact Index" which is complementary to h-index[19]. Miyairi and Chang analyzed bibliometric characteristics of highly cited papers published from 2000 to 2009 by scientists of Taiwan. The measures they have used for the analysis were citations, international collaborations, and top ten categories in which scientists have contributed[20]. Fu and others have conducted a study of bibliometric evaluation of highly cited papers from China published during the period from 1999 to 2009. For the analysis they used various measures like journals, subject categories, internationally collaborating countries, national inter-institutionally collaborating institutions, and most-cited papers in 22 scientific fields[21]. Results of both these studies reveal the position of Taiwan and China on the world map in case of publications and citations received for a particular time period.

Many studies have been conducted to evaluate the chemistry research worldwide. Research contributions of Indian chemists are also studied by many researchers. These studies are carried out using citation counts[22-25]. Evaluation of Indian contributions in organic chemistry during 1907-1926 was carried out by Guay[26]. Kademani and others have studied research productivity of scientists of Chemistry division of Bhabha Atomic Research Centre[27-28]. Bishop and others conducted research in the field of Chemoinformatics which was based on citation analysis of 321 papers published during the period 1980-2002[29].

This literature review reveals that citation analysis has been used by Indian researchers for evaluating research contributions of Indian scientists. Barring few studies, it has been observed that, hardly any study has been done to map or evaluate the contribution of a single department of an individual Indian university.

Objective of the study

To analyse the research contributions of the faculty members of the Department of Chemistry, University of Pune.

Methods

The data set for papers published during the period of 14 years (1999-2012) by the faculty members of the Department of Chemistry, University of Pune was collected from the Web of Science (WoS) database. The database was searched with necessary refinements and the Chemistry Department Knowledgebase (CDK) was created. CDK contains 811 papers published in 258 journals by thirty faculty members with 8948 citations.

Histcite (http://thomsonreuters.com/products_services/science/science_products/a-z/histcite/) software was used by many researchers for quantitative analysis of citations, authorship pattern, collaborations at national and international levels, etc. McCain and McCain used HistCite to study the Nash Equilibrium during 1950-2009[30]. In India, it was used by researchers especially for mapping of research in specific areas viz, mapping of tapioca research[31], cholera research[32], nanoscience and nanotechnology[33].

The network figure of international collaborations is drawn with the help of DOS based *IntColl* program by Loet Leydesdorff (http://www.leydesdorff.net/index.htm) and Pajek – Program for Large Network Analysis tool (http://vlado.fmf.uni-lj.si/pub/network/pajek). The data collected was analyzed with the help of the tools mentioned above.

Analysis

Author productivity and citations

Table 1 shows that thirty faculty members have published 811 papers during the 14 years (1999-2012) with an average 58 papers per year.

The table indicates that the Department's research publications are increasing every year. The 811 papers received total 8948 citations i.e. 11.03 citations

Table 1—Number of papers and citations received

Sl. no.	Publication year	No. of papers	%	Citations
1	1999	31	3.8	624
2	2000	18	2.2	338
3	2001	39	4.8	805
4	2002	37	4.6	806
5	2003	41	5.1	632
6	2004	47	5.8	1023
7	2005	61	7.5	757
8	2006	77	9.5	1276
9	2007	60	7.4	694
10	2008	69	8.5	716
11	2009	69	8.5	639
12	2010	82	10.1	376
13	2011	84	10.4	198
14	2012	96	11.8	64
	Total	811	100%	8948

Table 2—International collaborations

Sl. no.	Country	Papers	Citations	%	Number of authors
1.	USA	74	1693	9.1	2-31
2.	Germany	35	663	4.3	3-31
3.	UK	29	549	3.6	3-31
4.	France	12	140	1.5	4-11
5.	Japan	11	139	1.4	2-10
6.	Iran	8	15	1.0	3-6
7.	Italy	5	176	0.6	5-31
8.	Singapore	5	173	0.6	4-6
9.	Australia	4	317	0.5	2-10
10.	Brazil	4	41	0.5	3-10

per paper. However, more than 30% of papers (262) have been published in last three years (2010-2012) receiving 1917 citations. In 2012, 96 (11.8%) papers were published. This is the highest number of papers published in a single year. The highest number of citations 1276 were received for the 77 papers published in 2006.

H-index and self-citations

Individual h-index though available for each faculty member is not listed in this paper as the objective is not to rank them. As per the WoS database, Department of Chemistry has h-index 43 during the period under study. Self-citations in the collection are 1241 (13%).

Collaborations

International collaboration

Collaborations help extend horizon of ideas and it multiplies interpretations. Universalization and generalization of research is another advantage of collaborations. All the countries appearing in affiliation as entered in address field of the papers were analyzed. In CDK, the total 811 papers are written by thirty faculty members with collaboration of more than 1000 researchers from all over the world. With the help of HistCite, list of countries, number of papers and citations received were checked. The top ten countries, number of papers, citations, percentage and number of authors are listed in Table 2.

It is seen that USA leads in regard of the number of papers and citations followed by Germany, UK, France, Japan and others.

Number of authors were checked for papers published in collaboration with the top ten countries. Number of collaborations ranges from 2-31 authors. It was further found that a single paper is contributed by a faculty member with the collaboration of 30 other authors from USA, Germany UK, and Italy.

Network of collaborating countries

Out of the total 811 papers, only 12 papers have single authors and remaining 799 are published in collaboration with scientists from 34 countries. Figure 1 shows network of countries with which the faculty members have collaborated.

Red circles in Fig. 1 represent individual countries. Arrows show collaborations among the various countries. The figure does not indicate the number of papers but red circle with single line and arrow indicates the collaboration between the two countries viz. India and Iran, India and Malaysia, India and Portugal, etc. Multiple lines and multiple arrows indicates the collaboration between more than two countries viz. India, USA and Germany etc.

The collaboration network affirms that the Department has international collaborations with many countries of the world.

National collaboration

Table 3 lists institutions with which at least minimum five papers have been authored in collaboration.

There are total 393 papers published in collaboration with scientists at national level. Maximum number (29%) of collaborations is with National Chemical Laboratory (NCL) which is one of the laboratories under Council of Scientific Industrial Research (CSIR). Bhabha Atomic Research Centre (23%) is the next institute that the Department researchers collaborate with. Other CSIR Labs excluding NCL (16%) and Indian Institutes of Technology (16%) follow.

Preferred publishers for publications

Table 4 represents 14 journal publishers with their countries. These publishers are selected by the criterion of having published minimum ten and above papers.

Among the total 656 papers published, publishers from the USA (55%) and UK (30%) are predominant, followed by Germany (8%) and India (5%). A number of papers are published in prominent society journals viz., American Chemical Society, American Institute of Physics, etc.

Among the Indian publishers, CSIR-National Institute of Science Communication and Information Resources (NISCAIR) and Indian Academy of Sciences' journals are preferred.

International journals preferred

Table 5 lists 22 international journals in which 239 papers are published. The international journals were selected on the basis of citations received (100 and above).

The Impact Factor (IF) of these 22 journals was further checked. The papers published in these

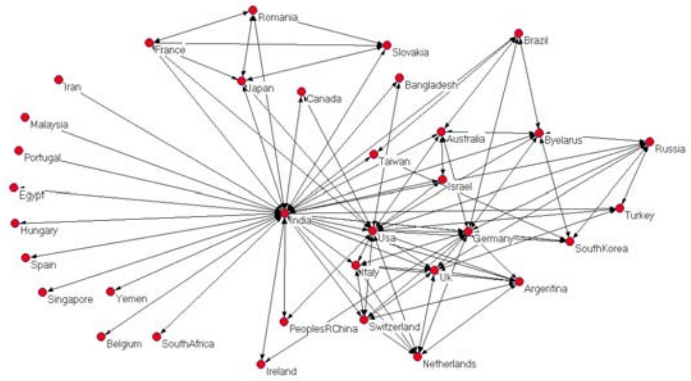

Fig. 1—International collaborations

Table 3—National collaborations

Sl. no.	Institute	Publications	%
1.	National Chemical Laboratory Pune (laboratory under CSIR, India).	113	29
2.	Bhabha Atomic Research Centre, Mumbai	89	23
3.	Council of Scientific Industrial Research (CSIR) India	64	16
4.	Indian Institutes of Technology (IITs), India	63	16
5.	Shivaji University, Kolhapur	21	5
6.	National Center for Cell Sciences, Pune	8	2
7.	High Energy Material Research Laboratory, Pune	7	2
8.	Jawaharlal Nehru Center For Advanced Scientific Research, Bangalore	7	2
9.	North Maharashtra University, Jalgaon	6	2
10.	Bharati Vidyapeeth, Pune	5	1
11.	Centre for Materials for Electronic Technology, Pune	5	1
12.	Dr Babasaheb Ambedkar Marathwada University, Aurangabad	5	1
	Total	393	100

Table 4—Publisher-wise papers

Sl. no.	Publisher	Country	Papers	%
1.	Elsevier Science BV	USA	185	28
2.	American Chemical Society	USA	113	17
3.	Pergamon-Elsevier Science Ltd	UK	109	17
4.	Springer	Germany	54	8
5.	Royal Society of Chemistry	UK	40	6
6.	American Institute Physics	USA	31	5
7.	Taylor & Francis Inc	UK	25	4
8.	National Institute of Science Communication & Information Resources.	India	25	4
9.	Wiley-Blackwell	UK	18	3
10.	Indian Academy of Sciences	India	13	2
11.	Academic Press Inc Elsevier Science	USA	11	2
12.	American Scientific Publishers	USA	11	2
13.	John Wiley & Sons Inc	USA	11	2
14.	Georg Thieme Verlag Kg	UK	10	2
	Total		656	100%

Table 5—International Journals

Sl. no.	Journal	Papers	Citations	Impact Factor (JCR-2012)
1.	*Journal of Physical Chemistry A*	41	905	2.946
2.	*Journal of Organic Chemistry*	17	459	4.601
3.	*Sensors And Actuators B-Chemical*	7	401	3.898
4.	*Journal of Chemical Physics*	25	374	3.333
5.	*Tetrahedron Letters*	30	262	2.683
6.	*Journal of Applied Physics*	5	232	2.168
7.	*Journal of Inorganic Biochemistry*	9	230	3.354
8.	*Tetrahedron*	18	222	3.025
9.	*Bioorganic & Medicinal Chemistry Letters*	10	219	2.554
10.	*Proceedings of The National Academy of Sciences of The United States of America*	1	198	9.681
11.	*Inorganica Chimica Acta*	10	194	1.846
12.	*Materials Chemistry and Physics*	7	192	2.234
13.	*Inorganic Chemistry*	7	152	4.601
14.	*Journal of Medicinal Chemistry*	3	148	5.248
15.	*Acta Crystallographica Section B-Structural Science*	1	132	2.286
16.	*Inorganic Chemistry Communications*	7	120	1.972
17.	*Bioorganic & Medicinal Chemistry*	8	116	2.921
18.	*Journal of Computational Chemistry*	5	113	4.583
19.	*Physical Chemistry Chemical Physics*	9	108	3.573
20.	*Organic & Bio molecular Chemistry*	8	107	3.354
21.	*Materials Letters*	7	104	2.307
22.	*Radiation Physics and Chemistry*	4	103	1.227
	Total	239	5091	Average 3.381

journals received total 5091 citations. The average impact factor of these journals is 3.381. It is noticed that, 57% of the total citations (8948) received for the papers, are published in these journals.

Indian journals preferred

Table 6 lists nine Indian journals in which the faculty members have contributed 41 papers.

The highest number of papers (17) are published in *Indian Journal of Chemistry Section A,* have received highest number (79) of citations. It indicates that contributions are more in physical, inorganic and analytical chemistry in case of publications in Indian journals.

Areas of research

Table 7 lists subject areas according to WoS categories in which more than 10 papers are published by the faculty members of the Department.

The table shows that physical chemistry tops the list with 24.2% of total publications. Organic chemistry ranks second with 21.3%. Interdisciplinary research is seen from the areas like nanotechnology, biotechnology, environmental sciences, etc.

Authorship pattern and citation trends

Table 8 shows authorship pattern of publications by the faculty members.

There are 12 papers written by single faculty member receiving 55 citations. Highest numbers of papers (197) are authored by four researches which eventually got highest number of citations followed by, publications (169) by three authors with 1729 (19%) citations. It is noticed that there is one paper jointly written by 31 authors with 132 (1%) citations. This and other data in the table indicates that multi-authored papers received more citations than single author papers.

Table 6—Indian journals

Sl. no.	Journal name	Papers	Citations
1.	*Indian Journal of Chemistry Section A-Inorganic Bio-Inorganic Physical Theoretical & Analytical Chemistry*	17	79
2.	*Indian Journal of Chemistry Section B-Organic Chemistry Including Medicinal Chemistry*	8	15
3.	*Indian Journal of Chemical Technology*	4	9
4.	*Indian Journal of Biochemistry & Biophysics*	3	11
5.	*Indian Journal of Heterocyclic Chemistry*	3	4
6.	*Indian Journal of Engineering And Materials Sciences*	2	0
7.	*Indian Journal of Pure & Applied Physics*	2	1
8.	*Indian Journal of Experimental Biology*	1	10
9.	*Indian Journal of Pharmaceutical Sciences*	1	0

Table 7—Areas of research

Sl. no.	Areas of Research	Papers	%
1.	Chemistry, Physical	196	24.2
2.	Chemistry, Organic	173	21.3
3.	Chemistry, Multidisciplinary	119	14.7
4.	Physics, Atomic, Molecular & Chemical	101	12.5
5.	Materials Science, Multidisciplinary	77	9.5
6.	Chemistry, Inorganic & Nuclear	73	9.0
7.	Biochemistry & Molecular Biology	41	5.1
8.	Chemistry, Analytical	40	4.9
9.	Physics, Applied	37	4.6
10.	Nanoscience & Nanotechnology	36	4.4
11.	Chemistry, Medicinal	31	3.8
12.	Physics, Condensed Matter	26	3.2
13.	Biotechnology & Applied Microbiology	22	2.7
14.	Environmental Sciences	22	2.7
15.	Polymer Science	22	2.7
16.	Electrochemistry	18	2.2
17.	Engineering, Chemical	18	2.2
18.	Crystallography	17	2.1
19.	Nuclear Science & Technology	16	2.0
20.	Chemistry, Applied	15	1.8
21.	Biophysics	13	1.6
22.	Pharmacology & Pharmacy	12	1.5
23.	Biochemical Research Methods	10	1.2
24.	Metallurgy & Metallurgical Engineering	10	1.2
25.	Multidisciplinary Sciences	10	1.2

Findings

- Faculty members of the Department of Chemistry, University of Pune, have published 811 publications during 14 years (1999-2012) in various areas of chemistry in

Table 8—Authorship pattern

Number of authors	Number of papers	Citations received
1	12	55
2	145	1260
3	169	1729
4	197	2163
5	117	1447
6	78	807
7	43	563
8	18	288
9	7	12
10	17	436
11	4	29
12	2	1
14	1	26
31	1	132
Total	811	8948

which physical chemistry dominates. There is a continuous growth in publications. Highest number of papers were published in 2012. 30% of the total papers were published after 2010.

- Most of the faculty members disseminate their research output through international journals. Approximately 57% citations are received for papers published in 22 foreign journals. Core international journals like *Journal of Physical Chemistry A, Tetrahedron, Journal of Chemical Physics*, etc. are preferred by the faculty members. Nine Indian journals were selected to report research contributions which are indexed in WoS.
- H-index of the department is 43 during the period under study. Highest number of citations are received for 77 papers published in 2006.
- As far as international collaboration is concerned, highest number of papers are published with the researchers from the USA. Within the country, collaborations with National Chemical Laboratory dominates.
- International journals published by USA, UK and Germany are preferred by the faculty members.
- Most of the papers are published in journals having an impact factor more than one.
- The authorship pattern varies from 2 to 31 authors and there are very few papers by a single author in the CDK.

Conclusion

The quantitative analysis of papers published by faculty members of the Department of Chemistry, University of Pune shows that the faculty members are very active in research and their contribution is well recognized at national and international level. They prefer core journals having high impact factor to publish their research. The number of their contributions is growing especially in the years 2010-2012. Though the main area of research is physical chemistry the faculty members also do research in interdisciplinary areas like computational chemistry, nanotechnology, etc.

Acknowledgements

Author is thankful to Dr. S. Gunasekaran, Sr. Technical Officer at CSIR-Central Electrochemical Research Institute Karaikudi, India; Amogh Lokhande, Institute of Chemical Technology, Mumbai; Mrs. Asha Umarani, Associate Professor (Retd.) and Prof. Rajendra Kumbhar, Department of Library and Information Science, University of Pune for the valuable inputs and help in writing the paper.

References

1. Garfield E, Science Citation Index-A new dimension in indexing, *Science*, 144 (3619) (1964) 649-654.
2. Vallmitjana N, Sabaté L, Citation analysis of Ph. D. dissertation references as a tool for collection management in an academic chemistry library, *College & research libraries*, 69 (1) (2008) 72-82.
3. Gordon M D, Citation ranking versus subjective evaluation in the determination of journal hierachies in the social sciences, *Journal of the American Society for Information Science*, 33 (1) (1982) 55-57.
4. Garfield E, Citation analysis as a tool in journal evaluation, *Science*, 178 (4060) (1972) 471-479.
5. Osareh F, Zare A, *A Study on Scientific Product of the University of Tehran in Web of Science Database during 1989 – 2009, Technological Convergence and Social Networks in Information Management*, (Heidelberg; Springer), 2010, p. 211-221.
6. Meho L I, *The rise and rise of citation analysis*, Available at Arxiv preprint physics/0701012 (Accessed on 24 March 2014).
7. Meho L I, Yang K, Impact of data sources on citation counts and rankings of LIS faculty: Web of Science versus Scopus

and Google Scholar, *Journal of the American Society for Information Science and Technology*, 58 (13) (2007) 2105-2125.

8. Levine-Clark M, Gil E, A comparative analysis of social sciences citation tools, *Online information review*, 33 (5) (2009) 986-996.
9. Garfield E, Pudovkin A I and Istomin V S, Why do we need algorithmic historiography?, *Journal of the American Society for Information Science and Technology*, 54 (5) (2003), 400-412.
10. Garfield E, PudovkincA I and Istomin V S, Algorithmic citation-linked historiography—Mapping the literature of science, *Proceedings of the American Society for Information Science and Technology*, 39 (1) (2002) 14-24.
11. Garfield E, Pudovkin A I, *The HistCite system for mapping and bibliometric analysis of the output of searches using the ISI Web of Knowledge*, Available at http://garfield.library.upenn.edu/papers/asist112004.pdf (Accessed on 24 March 2014).
12. Kademani B, Kalyane V, Bibliometric indicators for publication productivity analysis of an individual scientist, *ISSI: the International Journal of Sscientometrics and Informetrics*, 2 (4) (1996) 49-58.
13. Seglen P O, Aksnes D W, Scientific productivity and group size: A bibliometric analysis of Norwegian microbiological research, *Scientometrics*, 49 (1) (2000) 125-143.
14. Schubert A, Braun T, Some scientometric measures of publishing performance for 85 Hungarian research institutes, *Scientometrics*, 3 (5) (1981) 379-388.
15. Phillimore A, University research performance indicators in practice: The University Grants Committee's evaluation of British universities, 1985–86, *Research Policy*, 18 (5) (1989) 255-271.
16. Lee C K, A scientometric study of the research performance of the Institute of Molecular and Cell Biology in Singapore, *Scientometrics*, 56 (1) (2003) 95-110.
17. Garg K, Rao M K D, Bibliometric analysis of scientific productivity: A case study of an Indian physics laboratory, *Scientometrics*, 13 (5) (1988) 261-269.
18. Torres-Salinas D, Lopez-Cózar E D and Jiménez-Contreras E, Ranking of departments and researchers within a university using two different databases: Web of Science versus Scopus, *Scientometrics*, 80 (3) (2009) 761-774.
19. Molinari J F, Molinari A, A new methodology for ranking scientific institutions, *Scientometrics*, 75 (1) (2008) 163-174.
20. Miyairi N, Chang H W, Bibliometric characteristics of highly cited papers from Taiwan, 2000–2009, *Scientometrics*, 92 (1) (2012) 197-205.
21. Fu H Z, Chuang K Y, Wang M H and Ho Y S, Characteristics of research in China assessed with Essential Science Indicators, *Scientometrics*, 88 (3) (2011) 841-862.
22. Klaić B, Analysis of the scientific productivity of researchers from The Republic of Croatia for the period 1990–1992, *Scientometrics*, 32 (2) (1995) 133-152.
23. Klaić B, Scientometric analysis of the research activities of chemists from the "Rugjer Bošković" Institute (Yugoslavia), 1976–1985, *Scientometrics*, 19 (1) (1990) 11-24.
24. Kim M J, Kim B J, A bibliometric analysis of publications by the Chemistry Department, Seoul National University, Korea, 1992-1998, *Journal of Information Science*, 26 (2) (2000) 111-119.
25. Vinkler P, *Bibliometric analysis of publication activity of a scientific research institute*, Available at https://uhdspace.uhasselt.be/dspace/handle/1942/869 (Accessed on 24 March 2014).
26. Guay Y, Emergence of basic research on the periphery: Organic chemistry in India, 1907–1926, *Scientometrics*, 10 (1) (1986) 77-94.
27. Kademani B, Surwase V, Sagar A, Mohan L, Gaderao C, Kumar A, Kalyane V and Prakasan E, Scientometric dimensions of innovation communication productivity of the Chemistry Division at Bhabha Atomic Research Centre, *Malaysian Journal of Library and Information Science*, 10 (1) (2005) 65.
28. Kademani B, Kumar V, Surwase G, Sagar A, Mohan L, Kumar A and Gaderao C, Research and citation impact of publications by the Chemistry Division at Bhabha Atomic Research Centre, *Scientometrics*, 71 (1) (2007) 25-57.
29. Bishop N, Gillet V J, Holliday J D and Willett P, Chemoinformatics research at the University of Sheffield: a history and citation analysis, *Journal of Information Science*, 29 (4) (2003) 249-267.
30. McCain K W, McCain R A, Influence & Incorporation: John Forbes Nash and the "Nash Equilibrium", *Proceedings of the American Society for Information Science and Technology*, 47 (1) (2010) 1-2.
31. Balasubramani R, Murugan C, *Mapping of Tapioca (Sago) Research in India: A Scientometric Analysis.* Available at http://digitalcommons.unl.edu/libphilprac/546/ (Accessed on 24 March 2014).
32. Thulasi K, Arunachalam S, Mapping of cholera research in India using HistCite, *Annals of Library and Information Studies*, 57 (3) (2010) 310-326.
33. Karpagam R, Gopalakrishnan S, Natarajan M, and Babu B R, Mapping of nanoscience and nanotechnology research in India: a scientometric analysis, 1990–2009, *Scientometrics*, 89 (2) (2011) 501-522.