Indian Journal of Chemistry
Vol. 51B, January 2012, pp. 269-284

## Rapid Communication

# Visibility and impact of the Indian Journal of Chemistry, Section B during 2005-2009 using scientometric techniques

P Nishy, Prema Parvatharajan* & Gangan Prathap

CSIR National Institute of Science Communication and Information Resources, Dr. K S Krishnan Marg, New Delhi 110 012, India

E-mail: prmparvatharajan@gmail.com

*Received 18 July 2011; accepted (revised) 12 October 2011*

Organic chemistry has always been one of the strongest areas of research in the chemical sciences in India. The Indian Journal of Chemistry, Section B is the leading journal from India covering important contributions in the area of organic and medicinal chemistry. This is the first attempt to carry out a scientometric assessment of the visibility and impact of this journal towards serving the needs of researchers, mainly from India, in these areas. All papers published in this journal during 2005 to 2009 have been analysed using various scientometric parameters like geographical distribution, citations received each year, authorship patterns, *etc*. The papers are grouped under four main fields: (i) Heterocyclic Chemistry, (ii) Synthetic Organic Chemistry, (iii) Natural Products Chemistry and (iv) Theoretical Chemistry and assessment and performance of these and the forty five specialized sub-fields in organic chemistry have been studied.

**Keywords**: Indian Journal of Chemistry, Section B, Organic Chemistry, heterocyclic, theoretical chemistry, asymmetric, chemoenzymatic, synthesis, natural products, antimicrobial activity, biological activity

The scholarly journal is the most important platform for recording and communicating research and related scholarly activities. It is therefore natural that journals have been usually employed as a functional unit for analysis of a subject area by many bibliometricians. The fundamentals of publication evaluation by means of scientometric methods have been laid down by Moravcsik[1] and Martin[2,3]. Many factors, such as journal citation analysis, journal productivity, and peer evaluation by subject experts may be employed to rate the journals. Scientometric techniques are used for assessing the visibility and impact of scientific journals. Traditionally, journal evaluation tried to quantify the influence, prestige, impact or popularity of journals as impact factor, which is a measure or proxy for quality of the average article appearing in a prescribed window of years, *e.g*. a two year window for the journal impact factor assigned by Thomson-Reuters. Recently, other journal ranking indicators like Article Influence (AI), SCImago Journal Rank (SJR), and Source-Normalized Impact per Paper (SNIP) have also been promoted as proxies for journal quality. These indicators take care of the quality angle but not the size factor, which is the number of articles published in a year or the number of citations received in a year. Another approach is to use the *h*-index for journal evaluation. A journal's citation analysis[4] has become a dominant evaluation tool with application to various disciplines and a detailed study of a journal can also show how knowledge in a domain is changing, developing, or becoming obsolete and this helps to optimize an information retrieval system. A journal's citation index plays an important role in a researcher's academic life. Similarly, these scientometric techniques are important for evaluating the research performance of universities and institutions[5-11].

Chemistry has emerged as one of the important fields of science which acts as a bridge between the physical and biological sciences. Organic and medicinal chemistry areas have developed as important fields mainly due to their importance in drug discovery and the chemical industry. Karki *et al*.[12a] has studied bibliometrics of alkaloid research in India and organic chemistry research[12b] during 1970-1980.

Portrait of Chemistry for sustainable development[13a] and bibliometric analysis of the journal *Uspekhi Khimii* (Russian Chemical Reviews) was done by Zibareva *et al*.[13b] The bibliometric analysis of *Journal of Structural Chemistry* was carried out by Buznik *et al*.[14] Recently, statistical data on publication began to be employed by bibliometric (informetrics) methods for obtaining numerical characteristics of scientific journals such as *Angewandte Chemie*[15] and *Inorganica Chemica Acta*[16]. Bibliometric studies of journal publications on analytical chemistry during 2000-2007, and publication productivity and journal preferences by country has been studied by Tellèz *et al*.[17] Synthetic organic chemistry research analysis by scientometric indicators and trends in synthetic organic chemistry research using cross-country comparison of activity index was carried out by

Kumari[18a,b]. Scientometric studies on chemistry and aims and methods of producing new chemical substances were carried out by Schummer[19]. Study of interdisciplinarity in chemistry research based on the production of Puerto Rican scientists during 1992-2001 was done by Elias Sanz-Casado[20].

Willett[21] studied the bibliometric analysis of the literature of cheminformatics. Bibliometric analysis of Chinese research on cyclization, MALDI-TOF ((Matrix Assisted Laser Desorption/Ionization Time-of-flight Mass spectrometry) and antibiotics was studied by Jiang Li[22]. The structure of Iranian chemistry research during 1990-2006 with author co-citation analysis was also studied by Farideh Osarch[23]. Scientometric indices of chemical institutions of Novosibirsch were evaluated by Buznik *et al.*[24] A bibliometric analysis of volatile organic compounds was conducted and research trends were studied by Zhang *et al*.[25] Research on spectroscopy in Morocco from 1984 to 1996 was evaluated by Armenta *et al.*[26] National level performance in analytical chemistry was done by Annibaldt *et al*.[27] using scientometric techniques. Scientific output in analytical chemistry of Croatia was analyzed by Kastelan-Macan *et al*.[28] Although bibliometrics started essentially as a descriptive science, systematically arranged bibliometric data form the basis for quantitative analysis and serve to reveal some latent tendencies in the development of a particular journal and to formulate the proposals aimed at making it a more effective and prestigious vehicle for communication among the scientific community. Today there is evidence that many Indians prefer to publish their best work in international journals, leaving lower impact results for home journals[29]. This is a vicious circle, and even as data depositories, Indian journals have become less important and lag behind the World's leading journals in ratings of popularity or prestige.

Indian Journal of Chemistry has been started in 1963 and bifurcated into two independent journals in 1976 as (i) Indian Journal of Chemistry, Section A (IJCA) which deals with inorganic, bio-organic, physical, theoretical and analytical chemistry research and (ii) Indian Journal of Chemistry, Section B (IJCB) which publishes organic and medicinal chemistry research. These journals are published by the CSIR-National Institute of Science Communication and Information Resources (CSIR-NISCAIR), New Delhi. Indian Journal of Chemistry, Section B publishes original research papers belonging to organic, natural products, synthetic, medicinal and theoretical organic chemistry. The journal also welcomes papers dealing with chemoenzymatic and enantioselective synthesis of organic compounds, synthesis of fullerenes, metal catalyzed asymmetric reactions, bioactive plant products and combinatorial chemistry. The journal is available free online and in open access from March 2009.

Indian Journal of Chemistry, Section B, IJCB (ISSN 0376-4699) has published around 114000 papers from 1974 to 2010. It is a leading journal from India and abstracted/indexed in most of the international abstracting and indexing journals and databases such as Beilstein, Biosis, Biobase, Chemical Abstract, Indian Science Abstract, Medical Document Service (ISI Product), Nutrition Abstract, Analytical Abstract, Science Abstract, Science Citation Index, Biotech Abstract, Current Content, Current Advanced Ecology, EMBASE, Environmental Science, Current Leather Literature, Food Science & Technology Abstract and SCOPUS.

The present paper analyses the study of IJCB papers published during the period from 2005 to 2009. This is the first time that studies using the specialized sub-fields to evaluate the performance of organic chemistry are being carried out applying published papers in the Indian Journal of Chemistry, Section B.

## Objective of the study

The objective of the study is to evaluate the journal, IJCB, based on different bibliometric parameters, such as the pattern of growth of the research papers published. During 2005-2009, citations of these papers, number of contributing authors, papers contributed from India and foreign countries, types of references cited and subject analysis have been studied to know the growth of the journal.

## Methodology

The bibliographic and citation data of IJC-B has been downloaded from Science Citation Index-Expanded (SCI-E) of Thomson Reuters, Philadelphia, PA, USA, and the bibliometric parameters and indices studied on the journal papers that appeared during 2005-2009. The downloaded bibliographic data has been analyzed using Microsoft Excel to study the growth/pattern of authors, cited references, citations received, subjects based on keywords, *etc*. One thousand and sixty two abstracts of the papers published in the journal during 2005-2009 are

analyzed for the subject distribution and categorized into four main fields of organic chemistry such as (i) Heterocyclic Chemistry, (ii) Synthetic Organic Chemistry, (iii) Natural Products Chemistry and (iv) Theoretical Chemistry. Further, these four main subjects are studied under forty five sub-subjects.

## Results and Discussion

### Pattern of inflow of papers

During 2005-2009 IJCB has published 60 issues and 1062 papers. Out of these, 1015 are articles including rapid communications and short notes, 33 proceedings papers and five corrections. Three special issues have been published with six Editorials. The special issues are (i) Green/Sustainable Chemistry, (ii) Recent developments in heterocyclic chemistry, and (iii) Interplay of Chemical and Biological Sciences: Impact on Health and Environment. One Editorial letter has also been published during the study period. Two review articles on "Nitrogen ligands: The transition metal catalyzed reaction of aryl halides with olefins (Mizoroki-Heck), phenylboronic acid (Suzuki coupling) and Buchwald-Hartwig amination, new catalysts and effect of co-catalysts – Aryl halide activation – Part I", and "Deoximation of keto- and aldoximes to carbonyl compounds" have been published in IJCB during 2005-2009.

### Growth pattern of Publications

**Table I** shows the analysis of the IJCB papers from SCI-E database downloaded in December 2010.

**Table I** — Growth of the publications with impact factor of the journal during 2005-2009

| Publication Year | Papers | IF | % of non cited papers |
|---|---|---|---|
| 2005 | 273 | 0.446 | 26.37 |
| 2006 | 287 | 0.491 | 35.19 |
| 2007 | 183 | 0.368 | 37.70 |
| 2008 | 158 | 0.466 | 38.61 |
| 2009 | 161 | 0.437 | 61.78 |

The inflow of the papers decreased from 2005 (273 papers) to 2009 (161) due to high rejection rate (50-60%) giving an average of 212 papers per year. The impact factor (IF) has not varied much and the average IF is 0.442. Publishing more review articles may help to improve the impact factor. The average value of non-cited papers are around 40% with a high value of 61.8% for 2009 due to the small citation window of only two years (2009-2010).

### Pattern of Citations

**Table II** shows many papers published during 2005-2009 which received citations in the publication year itself. The average citations per year vary from 60 to 135.6 and the average citation per paper during the period is between 0.45 and 2.53. The papers continued to receive a good number of citations even five years after publication which indicates that the articles published possess good research standards and relevant to the current field of research.

### Distribution of contributors/Authors

Analysis of publications (**Table III**) shows that single authored papers are only 35 (3.30%), 304 papers (28.63%) are by two authors and 518 (48.7%) by three or four authors. The single authored papers are in the range of 2.5 to 4.3% from 2005 to 2009. Papers by two authors decreased from 30% to 21.7% whereas multi authored (3&4) papers increased from 46.5 to 50.9%. The mega (5 and above) authored papers are in the range of 20% with minor variations in different years. All multi-disciplinary papers have contributions from multiple authors belonging to different fields.

### Pattern of publishing countries

IJCB publishes papers from 15 different countries. The contribution from Indian authors during the period 2005-2009 is 87.24% and the contributions

**Table II** — Papers and citations

| Pub. Year | Papers | Citations received | | | | | | | Avg. cit /year | Citation /Paper |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Total | | |
| 2005 | 273 | 14 | 80 | 122 | 161 | 174 | 141 | 692 | 135.6 | 2.53 |
| 2006 | 287 | | 13 | 66 | 145 | 122 | 117 | 463 | 112.5 | 1.61 |
| 2007 | 183 | | | 7 | 51 | 85 | 95 | 238 | 77 | 1.30 |
| 2008 | 158 | | | | 2 | 72 | 89 | 163 | 80.5 | 1.03 |
| 2009 | 161 | | | | | 13 | 60 | 73 | 60 | 0.45 |
| Total | 1062 | | | | | | | 1629 | | 1.53 |

from foreign institutes are 12.74%. **Table IV** shows the distribution of the contribution in different years. The contribution from Indian institutes have increased and reached 93.17% in 2009. The foreign contribution decreased from 13.19% to 6.83% which is primarily due to high rejection rate (50-60%). The major foreign authors are from the Peoples Republic of China, USA, Iran, Turkey, Egypt, *etc*. A total of 915 papers have been contributed by researchers from Indian institutions. Institutions from China, USA, Egypt and Iran have contributed 51, 21, 18 and 18 papers respectively during the study period.

## Contributing Organisations/ Institutions

The search for the highest contributing institutions/academies from India and foreign countries (**Table V**) shows that NW Normal University, China, Hebei University, China and Karadeniz Tech University, Turkey are among the major contributing universities from abroad. Most of the contributions are from Indian Universities and technical educational institutes. Kakatiya University, Indian Institutes of Technology (IITs), Bangalore University, University of Delhi and JNT University, Hyderabad are the major contributing Indian academies.

Indian research institutions such as the Council of Scientific and Industrial Research (CSIR) laboratories, The Institute of Science, Bombay and the Indian Association for the Cultivation of Science, Kolkata are also among the important contributors to IJCB. The major Indian private organizations contributing to IJCB are from the pharmaceutical laboratories like Dr Reddys Laboratories Ltd, Ranbaxy Research Laboratories and Cipla.

**Table-III** — Author distribution during 2005-2009

| Authors | 2005 | 2006 | 2007 | 2008 | 2009 | Total |
|---|---|---|---|---|---|---|
| 1 | 7 | 13 | 3 | 5 | 7 | 35 |
| 2 | 84 | 93 | 48 | 44 | 35 | 304 |
| Multi author (3&4) | 127 | 133 | 100 | 76 | 82 | 518 |
| Mega author (5 or more) | 55 | 48 | 32 | 33 | 37 | 205 |
| Grand Total | 273 | 287 | 183 | 158 | 161 | 1062 |

**Table IV** — Countries with papers published

| Authors from | Percentage contribution in year | | | | |
|---|---|---|---|---|---|
| | 2005 | 2006 | 2007 | 2008 | 2009 |
| India | 86.81 | 78.40 | 87.98 | 89.87 | 93.17 |
| Foreign | 13.19 | 21.60 | 12.02 | 10.13 | 6.83 |
| Peoples R China | 4.40 | 6.27 | 6.01 | 5.06 | 1.24 |
| USA | 1.83 | 2.44 | 2.73 | 1.27 | 1.24 |
| Iran | 2.56 | 2.44 | 1.09 | | |
| Turkey | 2.20 | 1.39 | 1.09 | 1.27 | |
| Egypt | 1.47 | 4.18 | | | |
| Japan | 2.20 | | | 1.27 | |
| Bangladesh | | 1.74 | 1.64 | | |

## Cited references

Cited references are studied to analyze the recent developments in the area used for research. Papers published in IJCB cite a large number of research papers and patents. The time distribution of these references with peak citing between two to five years after the publication of the issue indicates the use of new technologies and studies in the research field.

**Table VI** shows that out of 1062 research papers, 111 papers are with less than 10 cited references. Most of the papers (481) have 10 to 20 cited references and 302 papers between 20 to 30 references. There are 3 review articles with more than 100 references. There are six papers with no references as they are Editorials and Letters to the Editor, *etc*.

The age / year of the cited references from papers published in IJCB during 2005-2009 are shown in **Table VII**. A good amount of current papers 796 (4.19%) during 2006-2009 are cited in IJCB, and the most referred papers 4923 (25.91%), are from 2001 to

**Table V** — Most prolific Institutions/Universities publishing in IJCB

| Foreign University | Indian | | |
|---|---|---|---|
| | Govt Research Inst | Private Organization | Indian University |
| • NW Normal University – 10<br>• Hebei University -10<br>• Karadeniz Tech University - 8 | • CSIR – 100<br>• The Institute of Science -22<br>• IACS- 10 | • Dr. Reddys Lab -15<br>• Ranbaxy Res. Lab - 5<br>• Cipla- 4 | • Kakatiya University -39<br>• Indian Institutes of Technology- 28<br>• Bangalore University- 27<br>• University of Delhi- 26<br>• JNT University- 26<br>• Banaras Hindu University - 23<br>• Panjab University- 21 |

**Table VI** — Number of papers with cited references

| Number of references | Papers |
|---|---|
| 0 | 6 |
| <10 | 111 |
| 10-20 | 481 |
| 20-30 | 302 |
| 30-50 | 136 |
| 50-75 | 23 |
| >100 | 3 |
| Grand Total | 1062 |

**Table VII** — Time distribution of cited references

| Year of the reference | Reference | % |
|---|---|---|
| 2006-2009 | 796 | 4.19 |
| 2001-2005 | 4923 | 25.91 |
| 1996-2000 | 3860 | 20.32 |
| 1991-1995 | 2482 | 13.06 |
| 1994-1965< | 6938 | 36.52 |
| | 18999 | 100.00 |

**Table VIII** — References included

| Type | Total | % |
|---|---|---|
| Journal | 18992 | 86.64 |
| Patents/standards | 676 | 3.08 |
| Book | 645 | 2.94 |
| Ref/Hand/Index /Review Books | 373 | 1.70 |
| Encyclopedia/Dictionaries/ compendium, *etc*. | 140 | 0.64 |
| Chem/Biol Abstract | 108 | 0.49 |
| Thesis | 52 | 0.24 |
| Software | 52 | 0.24 |
| Proceedings/Symposiums/annual Reports | 43 | 0.20 |
| Others | 840 | 3.83 |
| Grand Total | 21921 | 100.00 |

2005, 3860 (20.32%) referred papers are from 1996 to 2000, and 2482 (13.06%) papers are from 1991 to 1995. The remaining 36% papers referred are from 1994 to 1965<. This result also shows that 64% of the referred papers are cited from the current literature and are not older than 10 years.

Papers in the journal cite patents, books, reference sources like dictionaries and handbooks apart from journal articles. Cited patents indicate the use of technology in the scientific study in the area of chemistry by researchers. Reference to handbooks, software, *etc*. indicates the experimental studies carried out for the papers.

**Table VIII** shows that most of the references included in the papers published in IJCB are journal articles (18992) followed by patents (676), books (645) and reference sources like dictionaries and handbooks (373), *etc*.

**Table IX** describes details of journals included as references. Among referred journal articles, 17106 (88.15%) are from foreign journals and only 2300 (11.85%) are referred from Indian journals, which clearly indicates that the work of Indian researchers are guided and motivated by foreign research. The maximum cited references are from *Tetrahedron Letters* 1441 (7.43%), Indian Journal of Chemistry, Section B 1299 (6.69%), *Journal of Organic Chemistry*, 1118 (5.76), *Journal of the American Chemical Society* 955 (4.92%), *Journal of Medicinal Chemistry* 798 (4.11%), *Tetrahedron* 772 (3.98%) and *Synthetic Communication* 588 (3.03%). The self citation of IJCB is 6.69%.

The maximum number of patents (**Table IX**) referred are US 208 (30.91%), WIPO 114 (16.94%), Japanese 92 (13.67%), German 87 (12.93%), European 76 (11.29%), British 34 (5.05%), French 14 (2.08%) and Indian 10 (1.49%). This shows that Indian patents are referred by Indian scientists at very low rate, only 1.49%.

## Highly Cited Papers

**Table X** describes highly cited papers from IJCB. All the highly cited 19 papers are from heterocyclic chemistry**.** The paper "Vilsmeier-Haack reagent: A facile synthesis of 2-chloro-3-formylquinolines from *N*-arylacetamides and transformation into different functionalities", Indian Journal of Chemistry, Section B, 44B, **2005**, 1868-1875 is cited 20 times. Four papers in this category are contributed by foreign authors and the rest from Indian Universities. Most of the highly cited papers are from the year 2005, primarily due to the bigger citation window.

## Subject analysis of IJCB papers

The abstracts of papers (1062) published in Indian Journal of Chemistry, Section B (IJCB) have been studied in detail for subject evaluation. The papers are categorized into four main subjects and progress of organic chemistry research using the following main

**Table IX** — Major foreign and Indian journals referred

Cited references

| Foreign journals | | | Indian journals referred | | Patents referred | |
|---|---|---|---|---|---|---|
| Journal | Country | Papers | Journal | Papers | Country | Patents |
| Tetrahedron Lett | England | 1441 | Indian J Chem B | 1299 | USA | 208 |
| J Org Chem | USA | 1118 | | | World IPO | 114 |
| J Am Chem Soc | USA | 955 | J Indian Chem Soc | 300 | Japan | 92 |
| J Med Chem | USA | 798 | | | Germany | 87 |
| Tetrahedron | England | 772 | Indian J Heterocyclc Chem | 164 | European | 76 |
| Synthetic Commun | USA | 588 | Indian J Chem | 81 | UK | 34 |
| Synthesis | Germany | 514 | Indian J Pharm Sci | 71 | France | 14 |
| Phytochemistry | England | 375 | Indian J Chem A | 58 | India | 10 |
| J Chem Soc Perk | England | 326 | Asian J Chem | 46 | Canada | 4 |
| Synlett | Germany | 310 | Curr Sci India | 33 | S. Africa | 5 |
| J Heterocyclic Chem | USA | 282 | Indian Drugs | 32 | Netherland | 4 |
| Bioorg Med Chem Lett | England | 275 | | | Belgium | 3 |
| J Chem Res | England | 241 | Indian J Exp Biology | 27 | Switzerland | 3 |
| Chem Rev | USA | 240 | Chem Indian J | 23 | Russia | 3 |
| Angew Chem Int Ed En | Germany | 236 | Oriental J Chem | 17 | Spain | 2 |
| J Chem Soc | England | 207 | J Sci Ind Res | 15 | Swedan | 2 |
| Eur J Med Chem | France | 194 | | | Hungary | 2 |
| Bioorgan Med Chem | USA | 158 | J Indian Council Chem | 13 | Applications | 6 |
| Heterocycles | Japan | 146 | Others | 121 | Total | 673 |
| Chem Pharm Bull Jpn | Japan | 145 | | | | |
| Org Lett | USA | 140 | | | | |
| J Nat Products | USA | 134 | | | | |
| Farmaco | Netherlands | 112 | | | | |
| Chem Commun | England | 108 | | | | |
| Chem Lett | Japan | 107 | | | | |
| J Chem Soc Chem Comm | England | 105 | | | | |
| Chem Soc Japan | Japan | 103 | | | | |
| Others | | 6976 | | | | |

fields are carried out. (i) Heterocyclic Chemistry, (ii) Synthetic Organic Chemistry, comprising the study of alicyclic, aliphatic, aromatic and simple molecules and other molecules which are not covered in heterocyclic chemistry (iii) Natural Products Chemistry and (iv) Theoretical Chemistry (**Table XI**).

These four main subjects are further divided into forty five sub-subjects as given in **Table XII**.

The biological and antimicrobial activities in the research are studied in the papers themselves which are published in IJCB.

The **Table XI** shows that most of the compounds synthesized belong to Heterocyclic Chemistry followed by Synthetic Organic Chemistry and Natural Product Chemistry. Furthermore, due to lack of antimicrobial and biological testing facilities in many Indian laboratories, most of the compounds synthesized / isolated from plants are published without conducting any activity studies. The papers published with biological and antimicrobial activity studies are from a handful of laboratories where testing facilities are available or have the financial means to send the compounds elsewhere for testing. The papers describing biological activity studies also number very less (77) as compared to those describing antimicrobial activity (186 papers) which

**Table X** — Highly cited papers

| Paper | Author | Citations Received |
|---|---|---|
| 1. Vilsmeier-Haack reagent: A facile synthesis of 2-chloro-3-formylquinolines from *N*-arylacetamides and transformation into different functionalities,.44, **2005,**.1868-1875. | Srivastava, A; Singh, R M (Banaras Hindu Univ) | 20 |
| 2. One pot synthesis of 3,4-dihydropyrimidin-2(1*H*)-ones/-thiones catalysed by zinc chloride: An improved procedure for the Biginelli reaction using microwaves under solvent free condition 44, **2005**,.23-826. | Pasha, M A; Swamy, N R; Jayashankara, V P (Bangalore Univ) | 15 |
| 3. Synthesis of 5-arylidene-2-aryl-3-(benzotriazoloacetamidyl)-1,3-thiazolidin-4-ones as analegesic and antimicrobial agents, 45, **2006**,. 526-531. | Asati, K C; Srivastava, S K; Srivastava, S D (Dr Hari Singh Gour Univ) | 13 |
| 4. Synthesis, antimicrobial and antiinflammatory activities of 4-oxothiazolidines and their 5-arylidenes, 44, **2005**,. 1262-1266. | Yadav, R; Srivastava, S D; Srivastava, S K (HS Gour Univ) | 12 |
| 5. Preparation, characterization and antimicrobial activity of fatty alkenoates, 44, **2005,** 1273-1276. | Rauf, A; Parveen, H (Aligarh Muslim Univ) | 12 |
| 6. Enamination of 1,3-dicarbonyl compounds catalyzed by tin tetrachloride, 46 **2007,** 535-539. | Zhang, Z H; Ma, Z C; Mo, L P (Hebei Normal Univ) | 12 |
| 7. Selective and clean oxidation of alcohols with benzimidazolium fluorochromate (BIFC) under solvent free conditions, 44, **2005,** 144-147. | Sivamurugan, V; Rajkumar, G A; Arabindoo, B; Murugesan, V (Anna Univ) | 11 |
| 8. Studies on the reactivity pattern of *in situ* generated tetraethylammonium superoxide with 2-oxazolin-5-ones, 44,**2005,**381-386. | Singh, K N; Kumar, R (Banaras Hindu Univ) | 11 |
| 9. Cobalt(II) chloride or manganese(II) chloride or tin(II) chloride promoted one pot synthesis of dihydropyrimidin-2(1*H*)-ones using microwave irradiation, 44, **2005,** 762-767. | Kumar, S; Saini, A; Sandhu, J S (Punjabi Univ) | 11 |
| 10. Rapid and efficient synthesis of some biological active 2-azetidinones under microwave irradiation,.44, **2005,** 2093-2096. | Desai, K G; Desai, K R (S Gujarat Univ) | 11 |
| 11. Synthesis of some 3,5-biphenyl-4*H*-1,2,4-triazole derivatives as antitumor agents, 44, **2005,** 2107-2113 | Bekircan, O; Gumrukcuoglu, N (Karadeniz Tech Univ) | 11 |
| 12. Synthesis and anti-inflammatory, analgesic, ulcerogenic and lipid peroxidation activities of 3,5-dimethyl pyrazoles, 3-methyl pyrazol-5-ones and 3,5-disubstituted pyrazolines, 44, **2005,**.2532-2537. | Amir, M; Kumar, S (Hamdard Univ) | 11 |
| 13. Antibacterial and antifungal studies on some new acetylcinnolines and cinnolinyl thiazole derivatives,.45, **2006,** 1704-1709 | Narayana, B; Raj, K K V; Ashalatha, B V; Kumari, NS(Mangalore Univ) | 11 |
| 14. A new and efficient method for the synthesis of 5-arylmethylene-pyrimidine-2,4,6-trione under solvent and catalyst free conditions, 46, **2007,**.660-663. | Reddy, C S; Nagaraj, A; Jalapathi, P (Kakatiya Univ) | 11 |
| 15. $ZrOCl_2.8H_2O$ as a new solid phase and recyclable catalyst for an efficient Knoevenagel condensation under solvent-free microwave irradiation conditions, 44, **2005,**.1301-1303 | Yakaiah, T; Reddy, G V; Lingaiah, B P V; Rao, P S; Narsaiah, B (Indian Inst Chem Technol) | 10 |
| 16. Synthesis of some novel pharmacologically active Schiff bases using microwave method and their derivatives formazans by conventional method, 44, **2005,** 2097-2101 | Desai, K G; Desai, K R (S Gujarat Univ) | 10 |
| 17. Synthesis and antioxidant activities of some 4-benzylidenamino-4,5-dihydro-1*H*-1,2,4-triazol-5-one derivatives, 45, **2006,** 715-718 | Yuksek, H; Kolayli, S; Kucuk, M; Yuksek, M O; Ocak, U; Sahinbas, E; Sivrikaya, E; Ocak, M (Kafkas Univ) | 10 |
| 18. Synthesis of *N*-3(4-(4-chlorophenyl thiazole-2-yl)-(2-(amino)methyl)-quinzoline-4(3*H*)-one and their derivatives for antitubercular activity, 45, **2006**, 1778-1781 | Pattan, S R; Reddy, V V K; Manvi, F V; Desai, B G; Bhat, A R (KLES Coll Pharm) | 10 |
| 19. Synthesis and bronchodilatory activity of new 4-aryl-3,5-bis(2-chlorophenyl)carbamoyl-2,6-dimethyl-1,4-dihydropyridines & their 1-substituted analogues, 46, **2007,** 115-121 | Suresh, T; Swamy, S K; Reddy, V M (Kakatiya Univ) | 10 |

**Table XI** — Main subjects with biological and antimicrobial activities

| Main subject | Without any activity | Antimicrobial activity | *Biological activity | Antimicrobial & Biological activity | Total |
|---|---|---|---|---|---|
| Heterocyclic Chemistry | 329 | 151 | 58 | 10 | 548 |
| Synthetic Organic Chemistry | 347 | 28 | 15 | 4 | 394 |
| Natural Products Chemistry | 94 | 7 | 4 | - | 105 |
| | **770** | **186** | **77** | **14** | **1047** |
| Theoretical chemistry | - | - | - | - | 15 |
| Total | | | | | **1062** |

*Biological activity includes the activity other than antimicrobial activity like anti tumor, antimalarial, anti-inflammatory, *etc*.

indicates that biological testing facilities are very limited in India. There are only 15 papers in Theoretical Organic Chemistry which shows there is still ample scope for research in Theoretical Organic Chemistry (**Table XII**).

Less than 2% work has been carried out in the fields of alkaloids, terpenoids, X-ray Crystallography, flavonods, carbohydrates, peptides, Green/Sustainable Chemistry, QSAR (Quantitative Structural-Activity Relationshp), cycloaddition, steroids, cyclization, enzymes, polymers, analytical methods used in organic chemistry, kinetics, atom electron density calculation, marine natural products, nucleotides, photochemistry, amino acids, antibiotics, combinatorial chemistry, metathesis, Molecular Orbital Calculation, AMI Study, calixarines, ionic liquids, dyes, mass spectroscopy, microbial products, Molecular modeling and organic reagents.

## Detailed sub-subject analysis of papers published

Sub-subject-1 is the main sub-subject first level classification, sub-subject 2 is the second level classification, using the sub-subject level 1 classification. With sub-subject level 2 classification, the compounds are synthesized / isolated from natural products (**Table XIII**).

## Conclusion

The scientometric studies and qualitative analysis shows that out of 1062 papers only two review articles are published in 2005-2009 which indicates that publication of more review articles are required to improve the impact factor of the journal. Citations begin from the same year of publication and are cited even after five years of publication which indicates good progress in Indian chemical research and the fresh manuscripts draw upon the most recently cited publications. Indians have contributed more to the journal (86.81-93.17%) during 2005-2009. Contributions from foreign countries are between 13.19% and 6.83% during 2005-2009. Therefore, more contributions from foreign countries and Indians staying abroad are required.

The authorship contribution studies show that single authored papers are only 3.06% of the total. Three authored papers are 30.14% which indicates that due to the multi-disciplinary nature of the fields, multi-authored papers are more numerous.

Contributions of Indian universities are greater than government, private, public and CSIR laboratories. The highest contributions are from Kakatiya University, 39 papers (3.67%) followed by Indian Institute of Technology, 28 papers (2.64%) and Bangalore University, 27 papers (2.54%). This indicates that the universities are contributing more papers to the Indian Journal of Chemistry, Section B while CSIR, IITs and IISc are publishing more papers abroad. Fifty percent references are cited from the period 1996-2009 which indicates that current work is published in Indian Journal of Chemistry, Section B. The reference study shows that minimum Indian journals 2274 (11.97%) and maximum foreign journals 16718 (88.3%) are quoted as references. This indicates that Indian scientists are highly motivated by foreign research. The maximum references are referred from *Tetrahedron Letters*, 1418 (7.47%) followed by Indian Journal of Chemistry, Section B, 1288 (6.78%), *Journal of Organic Chemistry*, 1099 (5.29%), *Journal of the American Chemical Society*, 941 (4.95%), *Journal of Medicinal Chemistry*, 777 (4.09%), *Tetrahedron*, 751 (3.95%), and *Synthetic Chemistry*, 536 (3.09%).

Patent analysis shows that among patents, a maximum number of foreign patents, *US* (30.9%), *WIPO* (16.94%), *Japanese* (13.67%) and *German* (12.93%) are included as references. Whereas, only

**Table XII** — Sub-subject analysis of the papers published

| Sub-subjects | | Papers in main subjects | | | | Total | % |
|---|---|---|---|---|---|---|---|
| | | H C | SOC | NPC | TC | | |
| 1. | Compounds without any sub-subject | 224 | 112 | 11 | 4 | 351 | 33.05 |
| 2. | Microwave synthesis | 72 | 49 | 0 | 0 | 121 | 11.39 |
| 3. | Medicinal chem and compounds having biological activities | 83 | 26 | 3 | 0 | 112 | 10.55 |
| 4. | Spectroscopy in characterization of Organic Compound | 57 | 26 | 20 | 0 | 103 | 9.70 |
| 5. | Catalysts | 37 | 55 | 0 | 0 | 92 | 8.66 |
| 6. | Natural Products Chemistry | 0 | 0 | 81 | 0 | 81 | 7.63 |
| 7. | Chemoenzymatic and enantioselective synthesis | 15 | 40 | 1 | 0 | 56 | 5.27 |
| 8. | Reagents in organic synthesis | 20 | 16 | 0 | 0 | 36 | 3.39 |
| 9. | Alkaloids | 17 | 2 | 4 | 0 | 23 | 2.17 |
| 10. | Terpenoids | 1 | 6 | 16 | 0 | 23 | 2.17 |
| 11. | X-Ray crystallography | 11 | 9 | 2 | 1 | 23 | 2.17 |
| 12. | Flavonoids | 2 | 6 | 14 | 0 | 22 | 2.07 |
| 13. | Carbohydrates | 2 | 9 | 10 | 0 | 21 | 1.98 |
| 14. | Peptides | 8 | 11 | 0 | 0 | 19 | 1.79 |
| 15. | Green/Sustainable Chemistry | 2 | 15 | 0 | 0 | 17 | 1.60 |
| 16. | QSAR (Quantitative Structural-Activity Relationshp) | 6 | 10 | 0 | 0 | 16 | 1.51 |
| 17. | Cycloaddition | 11 | 3 | 0 | 1 | 15 | 1.41 |
| 18. | Steroids | 2 | 5 | 8 | 0 | 15 | 1.41 |
| 19. | Cyclization | 8 | 2 | 0 | 0 | 10 | 0.94 |
| 20. | Enzymes | 1 | 9 | 0 | 0 | 10 | 0.94 |
| 21. | Polymers | 0 | 9 | 0 | 0 | 9 | 0.85 |
| 22. | Analytical methods used in organic chemistry | 2 | 4 | 2 | 0 | 8 | 0.75 |
| 23. | Kinetics | 1 | 4 | 0 | 1 | 6 | 0.56 |
| 24. | Atom electron density calculation | 2 | 2 | 0 | 1 | 5 | 0.47 |
| 25. | Marine natural products | 0 | 0 | 4 | 0 | 4 | 0.38 |
| 26. | Nucleotides | 3 | 4 | 0 | 0 | 7 | 0.66 |
| 27. | Photochemistry | 1 | 3 | 0 | 0 | 4 | 0.38 |
| 28. | Amino acids | 1 | 2 | 0 | 0 | 3 | 0.28 |
| 29. | Antibiotics | 4 | 0 | 0 | 0 | 4 | 0.38 |
| 30. | Combinatorial chemistry | 1 | 2 | 0 | 0 | 3 | 0.28 |
| 31. | Heterocyclic chemistry | 0 | 0 | 3 | 0 | 3 | 0.28 |
| 32. | Metathesis | 0 | 4 | 0 | 0 | 4 | 0.38 |
| 33. | Molecular Orbital Calculation | 3 | 0 | 0 | 0 | 3 | 0.28 |
| 34. | Semiemperical -, AMI Study, MO Calculation | 0 | 2 | 0 | 1 | 3 | 0.28 |
| 35. | Calixarines | 0 | 2 | 0 | 0 | 2 | 0.19 |
| 36. | Ionic liquids | 2 | 0 | 0 | 0 | 2 | 0.19 |
| 37. | Dyes | 1 | 0 | 0 | 0 | 1 | 0.09 |
| 38. | Mass spectroscopy | 0 | 1 | 0 | 0 | 1 | 0.09 |
| 39. | Microbial products | 0 | 0 | 1 | 0 | 1 | 0.09 |
| 40. | Molecular modelling | 1 | 0 | 0 | 0 | 1 | 0.09 |
| 41. | Organic reagents | 0 | 1 | 0 | 0 | 1 | 0.09 |
| 42. | Proteins | 1 | 0 | 0 | 0 | 1 | 0.09 |
| 43. | Resins | 0 | 1 | 0 | 0 | 1 | 0.09 |
| 44. | Synthetic Organic Chemistry | 0 | 0 | 1 | 0 | 1 | 0.09 |
| 45. | Theoretical Chemistry | 1 | 0 | 0 | 0 | 1 | 0.09 |
| | | 604 | 451 | 181 | 9 | 1245 | |

HC: Heterocyclic Chemistry; SOC: Synthetic Organic Chemistry; NPC: Natural Products Chemistry TC: Theoretical Chemistry

**Table XIII** — Detailed Sub-Subject analysis

**1. Heterocyclic chemistry**

| Sub-Subject-1 | Sub-Subject-2 | Total Papers | |
|---|---|---|---|
| Alkaloids | Catalysts | 6 | 16 |
| | Microwave synthesis with Medicinal Chemistry and compounds having biological activities | 1 | |
| | Reagents in organic synthesis with Catalysts | 1 | |
| | — | 8 | |
| Antibiotics | Medicinal chem and compounds having biological activities | 2 | 4 |
| | — | 2 | |
| Atom electron density calculation | | 2 | |
| Carbohydrates | | 2 | |
| Catalysts | Alkaloids | 1 | 37 |
| | Cycloaddition | 1 | |
| | Green/Sustainable Chemistry with Ionic liquids | 1 | |
| | Ionic liquids | 1 | |
| | Medicinal chem and compounds having biological activities | 2 | |
| | Microwave synthesis with Spectroscopy in characterization of organic compounds | 1 | |
| | Microwave synthesis | 7 | |
| | Reagents in organic synthesis | 1 | |
| | — | 22 | |
| Chemoenzymatic and enantioselective synthesis of organic and chiral compounds, metal catalysed asymmetric reactions | Semiempirical MO calculations | 1 | 15 |
| | Spectroscopy in characterization of org. Compds | 1 | |
| | X-Ray crystallography | 1 | |
| | Antibiotics | 1 | |
| | Catalysts | 1 | |
| | Cycloaddition | 1 | |
| | — | 9 | |
| Combinatorial chemistry | Antibiotics | 1 | |
| Cyclization | Amino acids | 1 | 7 |
| | Catalysts with Microwave synthesis | 1 | |
| | Catalysts | 2 | |
| | Spectroscopy in characterization of organic compounds | 1 | |
| | — | 2 | |
| Cycloaddition | | 9 | |
| Dyes | | 1 | |
| Enzymes | | 1 | |
| Flavonoids | | 2 | |
| Green/Sustainable Chemistry | Catalysts | 1 | |
| Kinetics | | 1 | |
| Medicinal Chem. and compounds having biological activities | Microwave synthesis | 1 | 67 |
| | QSAR (Quantitative Sructurlal –Activity Relationship) | 1 | |
| | Spectroscopy in characterization of organic compounds | 2 | |
| | — | 63 | |

*—Contd*

**Table XIII** — Detailed Sub-Subject analysis—*Contd*

| Sub-Subject-1 | Sub-Subject-2 | Total Papers | |
|---|---|---|---|
| Microwave synthesis | Catalysts in Green/Sustainable Chemistry | 1 | 62 |
| | Catalysts | 6 | |
| | Green/Sustainable Chemistry | 2 | |
| | Medicinal Chem. and compounds having biological activities | 1 | |
| | Molecular modeling | 1 | |
| | QSAR (Quantitative Sructurlal –Activity Relationship) | 1 | |
| | Reagents in organic synthesis | 4 | |
| | Spectroscopy in characterization of organic compounds | 2 | |
| | X-Ray crystallography | 1 | |
| | — | 43 | |
| Molecular Orbital Calculation | | 2 | |
| Peptides | Medicinal Chem. and compounds having biological activities with Spectroscopy in characterization of organic compounds | 1 | 8 |
| | Medicinal Chem. and compounds having biological activities | 1 | |
| | Proteins | 1 | |
| | Reagents in organic synthesis | 2 | |
| | Spectroscopy in characterization of organic compounds | 2 | |
| | — | 1 | |
| Photochemistry | | 1 | |
| QSAR (Quantitative Sructurlal –Activity Relationship) | Medicinal Chem. and compounds having biological activities | 2 | 6 |
| | — | 4 | |
| Reagents in organic synthesis | Cyclization | 1 | 11 |
| | Green/Sustainable Chemistry | 1 | |
| | Medicinal Chem. & compound having biological activities | 1 | |
| | Spectroscopy in characterization of organic compounds | 1 | |
| | — | 7 | |
| Spectroscopy in characterization of organic compounds | Analytical methods used in organic chemistry | 2 | 46 |
| | Combinatorial chemistry | 1 | |
| | Medicinal Chem. and compounds having biological activities | 2 | |
| | X-Ray crystallography | 4 | |
| | — | 37 | |
| Steroids | | 2 | |
| Terpenoids | | 1 | |
| Theoretical chemistry | Reagents in organic synthesis | 1 | 6 |
| | Molecular Orbital Calculation | 1 | |
| X-Ray crystallography | — | 4 | |
| Nucleotides | | 3 | |
| Without any sub-subject | | 223 | |
| **Total in Heterocyclic chemistry** | | **537** | |

*—Contd*

**Table XIII** — Detailed Sub-Subject analysis—*Contd*

**2. Synthetic Organic Chemistry**

| Sub-Subject-1 | Sub-Subject-2 | Total Papers | |
|---|---|---|---|
| Alkaloids | | 1 | |
| Amino acids | Peptides | 1 | 2 |
| | — | 1 | |
| Analytical methods used in organic chemistry | | 3 | |
| Atom electron density calculation | | 2 | |
| Calixarines | | 2 | |
| Carbohydrates | Catalysts with Enzymes | 1 | 9 |
| | Chemoenzymatic and enantioselective synthesis of organic and chiral compounds, metal catalyzed asymmetric reactions | 1 | |
| | Medicinal chemistry & compounds having biological activities | 2 | |
| | — | 5 | |
| Catalysts | Alkaloids with Chemoenzymatic and enantioselective synthesis of organic and chiral compounds, metal catalyzed asymmetric reactions | 1 | 55 |
| | Chemoenzymatic and enantioselective synthesis of organic and chiral compounds, metal catalyzed asymmetric reactions | 1 | |
| | Green/Sustainable Chemistry | 1 | |
| | Microwave synthesis | 4 | |
| | Polymers | 1 | |
| | Reagents in organic synthesis | 2 | |
| | — | 45 | |
| Chemoenzymatic and enantioselective synthesis of organic and chiral compounds, metal catalyzed asymmetric reactions | AMI Study | 1 | 29 |
| | Carbohydrates | 2 | |
| | Catalysts | 1 | |
| | Cycloaddition | 1 | |
| | Enzymes | 1 | |
| | Reagents in organic synthesis | 1 | |
| | Spectroscopy in characterization of organic compounds and Semiemperical calculation, AMI | 1 | |
| | Steroids | 1 | |
| | Terpenoids | 2 | |
| | — | 18 | |
| Combinatorial l chemistry | Steroids | 1 | 2 |
| | — | 1 | |
| Cyclization | Catalysts | 1 | 2 |
| | — | 1 | |
| Cycloaddition | Spectroscopy in characterization of organic compounds | 1 | 2 |
| | — | 1 | |
| Enzymes | Catalysts | 1 | 6 |
| | Chemoenzymatic and enantioselective synthesis of organic and chiral compounds, metal catalyzed asymmetric reactions | 3 | |
| | Ionic liquids | 1 | |
| | — | 1 | |

—-*Contd*

**Table XIII** — Detailed Sub-Subject analysis—*Contd*

| Sub-Subject-1 | Sub-Subject-2 | Total Papers | |
|---|---|---|---|
| Flavonoids | Spectroscopy in characterization of organic compounds | 2 | 6 |
| | — | 4 | |
| Green/Sustainable Chemistry | Catalysts | 2 | 14 |
| | Microwave synthesis | 1 | |
| | Reagents in organic synthesis | 1 | |
| | — | 10 | |
| Kinetics | | 4 | |
| Medicinal chem and compounds having biological activities | Carbohydrates | 1 | 17 |
| | Enzymes with Microwave synthesis | 1 | |
| | Spectroscopy in characterization of organic compounds | 1 | |
| | — | 14 | |
| Metathesis | Terpenoids | 1 | 3 |
| | — | 2 | |
| Microwave synthesis | Catalysts in Green/Sustainable Chemistry | 1 | 42 |
| | Catalysts | 8 | |
| | Chemoenzymatic and enantioselective synthesis of organic and chiral compounds, metal catalyzed asymmetric reactions | 2 | |
| | Green/Sustainable Chemistry | 3 | |
| | Peptides | 1 | |
| | Reagents in organic synthesis | 2 | |
| | — | 25 | |
| Nucleotides | Analytical methods used in organic synthesis | 1 | 4 |
| | — | 3 | |
| peptides | Medicinal chem and compounds having biological activities with Antibiotics | 1 | 9 |
| | — | 8 | |
| Photochemistry | | 3 | |
| Polymers | Catalysts | 2 | 8 |
| | — | 6 | |
| QSAR (Quantitative Srucurlal -Activity Relationship) | Medicinal chem and compounds having biological activities | 2 | 10 |
| | — | 8 | |
| Reagents in organic synthesis | Medicinal chem and compounds having biological activities | 2 | 10 |
| | Microwave synthesis and Peptides | 1 | |
| | Microwave synthesis | 1 | |
| | organic reagents | 1 | |
| | — | 5 | |
| Resins | | 1 | |
| Spectroscopy in characterization of organic compounds | Analytical methods used in organic chemistry | 1 | 20 |
| | Medicinal chem and compounds having biological activities | 2 | |
| | X-Ray crystallography and Mass spectroscopy | 1 | |
| | X-Ray crystallography | 2 | |
| | — | 14 | |

*—Contd*

**Table XIII** — Detailed Sub-Subject analysis—*Contd*

| Sub-Subject-1 | Sub-Subject-2 | Total Papers | |
|---|---|---|---|
| Steroids | | 3 | |
| Terpenoids | | 3 | |
| X-Ray crystallography | | 6 | |
| Without any sub-subjects | | 112 | |
| **Total in Synthetic Organic Chemistry** | | **390** | |
| **3. Natural Products Chemistry** | | | |
| Carbohydrates | Medicinal chem and compounds having biological activities | 1 | 2 |
| | — | 1 | |
| Flavonoids | | 3 | |
| Marine natural products | Steroids and Terpenoids | 1 | 3 |
| | — | 2 | |
| Medicinal chem and compounds having biological activities | | 1 | |
| Microbial products | | 1 | |
| Natural products chemistry (phytochem) and bioactive plant products | Alkaloids with Medicinal chem and compounds having biological activities | 2 | 81 |
| | Alkaloids | 1 | |
| | Analytical methods used in organic chemistry and Steroids | 1 | |
| | Carbohydrates and Spectroscopy in characterization of organic compounds | 1 | |
| | Carbohydrates | 7 | |
| | Chemoenzymatic and enantioselective synthesis of organic and chiral compounds, metal catalysed asymmetric reactions | 1 | |
| | Flavonoids and Carbohydrates | 1 | |
| | Flavonoids and Spectroscopy in characterization of organic compounds | 2 | |
| | Flavonoids and X-Ray crystallography | 1 | |
| | Flavonoids | 6 | |
| | Heterocyclic chemistry and Analytical methods used in organic chemistry | 1 | |
| | Heterocyclic chemistry | 2 | |
| | Marine natural products | 1 | |
| | Medicinal chem and compounds having biological activities | 1 | |
| | Spectroscopy in characterization of organic compounds and Carbohydrates | 2 | |
| | Spectroscopy in characterization of organic compounds | 11 | |
| | Steroids and Flavonoids | 1 | |
| | Steroids and Terpenoids | 1 | |
| | Steroids | 3 | |
| | Terpenoids and Alkaloids | 1 | |
| | Terpenoids and Carbohydrates | 5 | |
| | Terpenoids and Spectroscopy in characterization of organic compounds | 2 | |
| | Terpenoids and X-Ray crystallography | 1 | |
| | Terpenoids | 4 | |
| | - | 22 | |

*—Contd*

**Table XIII** — Detailed Sub-Subject analysis—*Contd*

| Sub-Subject-1 | Sub-Subject-2 | Total Papers |
|---|---|---|
| Spectroscopy in characterization of organic compounds | | 1 |
| Synthetic organic chemistry | Steroids | 1 |
| Terpenoids | | 1 |
| Without any sub-subjects | | 11 |
| **Total in Natural Products Chemistry** | | **105** |
| **4. Theoretical Chemistry** | | |
| Amino acids | | 1 |
| Atom electron density calculation | X-Ray crystallography | 1 4 |
| | — | 3 |
| Chemoenzymatic and enantioselective synthesis of organic and chiral compounds, metal catalyzed asymmetric reactions | Cycloaddition and Atom electron density calculation | 3 |
| Kinetics | | 1 |
| Nucleotides | | 1 |
| Synthetic organic chemistry | Kinetics | 1 |
| Without any sub-subjects | | 4 |
| **Total in Theoretical Chemistry** | | **15** |

1.49% *Indian* patents are referred, which once again shows that foreign work is referred more often than Indian work.

The subject analysis shows that the maximum number of papers are published without any antimicrobial and biological activity studies. Out of 1062 papers, 770 papers are published without any activity studies, 186 papers are published with antimicrobial activity and 77 papers with biological activity like antitumor, anti malarial, anti inflammatory, *etc*. The papers with antimicrobial and biological activity studies number only 14, which indicates that due to the lack of biological and antimicrobial activity testing facility in many laboratories, these tests may not have been carried out. The subject analysis also shows that maximum number of papers are published in heterocyclic chemistry (548 papers) followed by synthetic chemistry (394 papers). In Natural Product Chemistry, 105 papers are published. Theoretical Chemistry has only 15 papers which shows that there is ample scope for more research in Theoretical Chemistry. The simple papers account for 33.05%. Microwave synthesis accounts for 11.39% papers. Medicinal compounds having biological activity account for 10.55% papers, spectroscopy in characterization of organic compounds accounts for 9.70% papers, Catalysis accounts for 7.63% papers, natural product chemistry accounts for 6.51% papers, chemoenzymatic synthesis accounts for 5.27% papers, new reagents account for 3.39% papers, and alkaloids and terpenoids account for 2.17% papers. Less than 2% of the papers cover the sub-subject fields of X-Ray crystallography, flavonoids, carbohydrates, peptides, green/Sustainable Chemistry, QSAR (Quantitative Structural-Activity Relationshp), cycloaddition, steroids, cyclization, enzymes, polymers, Analytical methods used in organic chemistry, kinetics, atom electron density calculation, marine natural products, nucleotides, photochemistry, amino acids, antibiotics, combinatorial chemistry, metathesis, Molecular Orbital Calculation, AMI Study, calixarines, ionic liquids, dyes, mass spectroscopy,

microbial products, Molecular modeling and organic reagents. These results bring out a strong case for pursuing these modern fields more vigrously.

India is playing a major role in the field of organic chemistry research. The present study will help to evaluate the development of organic chemistry research in India. The publishing trend totally depends upon the contributors, pattern of contributions and quality of research. National and international scientific visibility is determined in organic chemistry. These studies indicate that for new innovations to be generated from different chemical laboratories, Indian researchers should publish more in journals of Indian origin in every field instead of adding to the productivity of journals of foreign origin. These studies will help the policy makers, academic councils and the science administration of the country to design and develop new research policies. Scientometric data can be analyzed in the sense of identifying centers associated with certain individuals and institutions. Publication performance of researchers, Institutes and universities in specialized fields provide publication patterns and ranking. Results and experiences of evaluation can be used by persons, teams, officials, boards, committees, *etc*. Research productivity in organic chemistry is rapidly growing in India due to the growth of pharmaceutical companies and new drug discoveries but the impact of these in India, as indicated by citation based indicators, still lags behind other countries, particularly the developed countries. This study is a step to promote the development of organic chemistry and help to improve quality of research in the Indian scenario.

## References


1 Moravesik M J, in *Handbook of Quantitative Studies of Science and Technology*, edited by A F J Van Raan (Elsevier Science Publishers B V, Amsterdam), **1988**, 11.
2 Martin B R & Irvin J, *Research Policy*, 12, **1983**, 61.
3 Martin B R, *Scientometrics*, 36, **1996**, 343.
4 Vinkler P, *Current Sci*, 79 (5), **2000**, 602.
5 Cronin B & Shaw D, *J Doc*, 55, **1999**, 402.
6 Uzun A, *Scientometrics*, 53, **2002**, 297.
7 Schoeppfin U & Glanzel W, *Scientometrics*, 50, **2001**, 301.
8 Schubert A, *Inorg Chim Acta*, 253, **1996**, 111.
9 Marx W, *Angew Chem Int Ed* (*Engl*), 40 (1), **2001**, 139.
10 Onodera N J, *Chem Inf Comput Sci*, 41, **2001**, 878.
11 Koehler W, *Scientometrics*, 51, **2001**, 117.
12 (a) Karki M M S & Garg K C, *J Chem Inf Comput Sci*, 37, **1997**, 157; (b) Karki M M S & Garg K C, *Scientometrics*, 45 (1), **1999**, 107.
13 (a) Zibareva I V & Derendyaev B G, *Chemistry for Sustainable Development*, 12, **2004**, 119; (b) Zibareva I V, Teplova T N & Nefedov O M, *Russian Chem Rev*, 76 (8), **2007**, 693.
14 Buznik V M, Zibareva I V & Peletskii-Piotuckh, *J Structural Chem*, 45 (6), **2004**, 1096.
15 Max W, *Angew Chem Int Ed* (*Engl*), 40 (1), **2001**, 139.
16 Schubhert A, *Inorg Chim Acta*, 253, **1996**, 111.
17 Tellez H &Vadillo J M, *Anal and Bioanal Chem*, 4, 397, **2010**, 1477.
18 (a) Kumari L, *Scientometrics*, 80 (3), **2009**, 559; (b) *ibid*, 67 (3), **2006**, 467.
19 Schummer J, *Scientometrics*, 39 (1), **1997**, 125.
20 Sanz-Casado E, Martin Moreno C, Carcia-Zorita C, Lusa M & Lascurain-Sanchez, *Information Research*, **2004**, 9, 4. http//informationr.net/ir/9-4/paper182 html.
21 Willett P, White Rose Research Online, http://eprints, whiterose.ac.uk/3559/
22 Jiang Li, *J Chem Inf and Model*, 50 (1), **2010**, 27.
23 Osarch F & Mccain K W, *J Am Soc Inf Sci and Tech*, 59, **2008**, 13.
24 Boznik V M, Zibareva I V, Sorokin N I & Filatova S, *Chemistry for Sustainable Development*, 13, **2005**, 677.
25 Zhang G, Xe S & Ho Y-S, *Scientometrics*, 83, **2010**, 477.
26 http://www.Informaworld.com/smpp/content-db-all-content=a7818.
27 Annibaldt A, Truzzi C & Illuminati S, *Anal Bioanal Chem*, DOI 10.1007/s00216-010-3804-3807.
28 Kastelan-Macan M & Branimir K, *Croatica Chemica Acta*, 73(1), **2000**, 1.
29 Nishy P, Parvatharajan P & Prathap G, *Current Science*, 100, **2011**, 1604.