

# Authorship Pattern and Degree of Collaboration in Indian Chemistry Literature

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## Abstract

*The study presents the trends in authorship pattern and author's collaborative research in Indian chemistry literature with a sample of 53,977 articles downloaded from SCI-Expanded database in Web of Science during the period 2000-2009. The average number of authors per article is 3.55 %. In the study the degree of collaboration (C) during the overall 10 years (2000-2009) is 0.03, but the year wise degree of collaboration is almost same in all the years of mean value 0.97. In the 10 years of period, the multi-authorship articles are higher and predominant on single authorship. The study found that the researchers in chemistry are keen towards team research or group research rather than solo research.*

**Keywords:** Chemistry, Authorship Pattern, Multi-authored, Collaboration

## 1. Introduction

The number of authors contributing to scholarly publications in terms of authorship pattern is an interesting part of any bibliometric study. A count of number of authors contributing to articles offers some indication to the degree of collaboration between authors. Cronin (2001) comments, authorship as "undisputed coin of the real in academia" and "absolutely central to the operation of the academic reward system". However, the concept of authorship was evolved over the course of the 20th century, with a steady increase in collaboration. This trend was anticipated by Price (1963), who stated, "by 1980 the single-author paper will be extinct" and scholarly publications will "move steadily toward infinity of authors per paper".

Collaborative research refers to a research in which any research project is being carried out by at least two people by engaging their efforts in mind and body. It is very common in the field of sciences as compare to humanities.

As part of literature search, the authors found various studies in different disciplines based on the authorship pattern and collaborative research. Some of the literatures are reviewed by the authors before conducting the current study. By observing the *Chemical Abstracts* for the period of 1910-1960, Price (1963) was among the first to study the authorship pattern and opined that multi-authored papers are gradually increasing with simultaneous reduction in single-authored papers. Vimala and Pullareddy (1996) analyzed the doctoral theses in zoology of Venkateswara University, Tirupati and concluded that although multiple-authorship is dominant, solo research also exists and degree of collaboration in research in zoology is 0.75 as a whole. O'Neill (1998) examined the authorship pattern in two theory based journals; one is from American journal *Educational Theory* (1955-1994) and another from Canadian journal *Journal of Educational Thought* (1970-1974). He found that majority of authorships were single in both the journals regardless of the date of publication

against de Solla Price's prediction that coauthorship would eventually increase and single-author paper will be extinct. Farahat (2002) examined the patterns of authorship in nineteen Egyptian journals of agricultural science and found that multiple-authorship was predominant and co-authored papers were accounted as 79 % of the sample. Cronin, Shaw and Berre (2003) observed the coauthorship and subauthorship collaboration in the scholarly journal literature of Psychology and Philosophy as manifested in the 20<sup>th</sup> century and highlighted the rates of coauthorship and importance of collaboration. They found that among a total of 2,707 articles of 2001, (74%) are single authored. Pillai (2007) did a study of the trends in authorship pattern and collaborative research in physics with a sample of 11,412 journals and 1,328 book citations collected from the doctoral dissertations of IISc and found that team research is being preferred and average value of degree of collaboration in journals was 0.08. Lee, Jones and Downie (2009) analyzed the proceeding papers published in ISMIR proceedings of nine years and found that the amount of collaboration as reflected in co-authorship has increased. Zafrunnisha and Pullareddy (2009) studied the authorship pattern and degree of collaboration in psychology by sampling 141 Ph. D theses of universities and found the predominance of the multi authored papers over single authored papers and the degree of collaboration was 0.53. Here, the author has made an attempt to study the authorship pattern and degree of research collaboration on Indian chemistry literature published during the period 2000-2009 and indexed in SCI-Expanded database.

## **2. Objectives of the study**

The objectives of the present study are:

- a. To identify the language-wise distribution of articles;
- b. To measure the year-wise growth and distribution of Indian chemistry scholarly literature;
- c. To examine the nature of authorship patterns in chemistry research;
- d. To study the single v/s multi- author papers and average number of authors;
- e. To determine the degree of research collaboration on chemistry literature.

## **3. Methodology**

A sample of 53,977 journal articles during 2000-2009 published from India and indexed in SCI-Expanded database of Web of Science, a proprietary product of Institute of Scientific Information (Thomson Reuters) is used for the study. The database was used during 11<sup>st</sup> August-15<sup>th</sup> April, 2010 for study. Here, a publication from India refers to the journal article contributed by an author who is affiliated to any Indian organizations being either main author or co-author.

In order to perform a quantitative analysis, this study considered only articles published in journals and indexed in the database. Publications classified as bibliographical-item, book reviews, correction, editorial material, letter, proceedings paper, review, meeting-abstracts, correction, news item etc. were not considered for the study. So, at the time of searching the database the search option was

selected to "article" only. And to get the publications of India, the address and country field option was chosen to "India" in the advanced search option of the database. Again, that data was refined by selecting the subject categories/areas defined in the database itself. At the time of the study, the SCI- Expanded database contained seven subject categories on Chemistry. After searching, all the records were imported to MS Excel file, analyzed and tabulated for making observations. And to calculate the degree of author's collaboration, the mathematical formula proposed by Subramanyam in 1983 is used.

#### 4. Analysis and Results

According to the objectives of the study, analysis and findings of the study are outlined below.

##### 4.1 Language

In the current study, seven languages i.e. English, Chinese, Danish, German, Japanese, Portuguese, and Rumanian were found as a medium of scholarly presentation. Majority of the articles with 99.97% (53,961 articles) are written in English language. The Table- 1 shows the languages of expression with the number of articles

**Table 1: Articles in Different Languages**

Sl. No.	Language	Record Count(No. of articles)	Percentage (%) of 53977
1	English	53961	99.97
2	Chinese	8	0.015
3	German	2	0.004
4	Japanese	2	0.004
5	Rumanian	2	0.004
6	Danish	1	0.002
7	Portuguese	1	0.002
<b>Total</b>	-	<b>53977</b>	<b>100</b>

##### 4.2 Year-wise Distribution of Article Publications

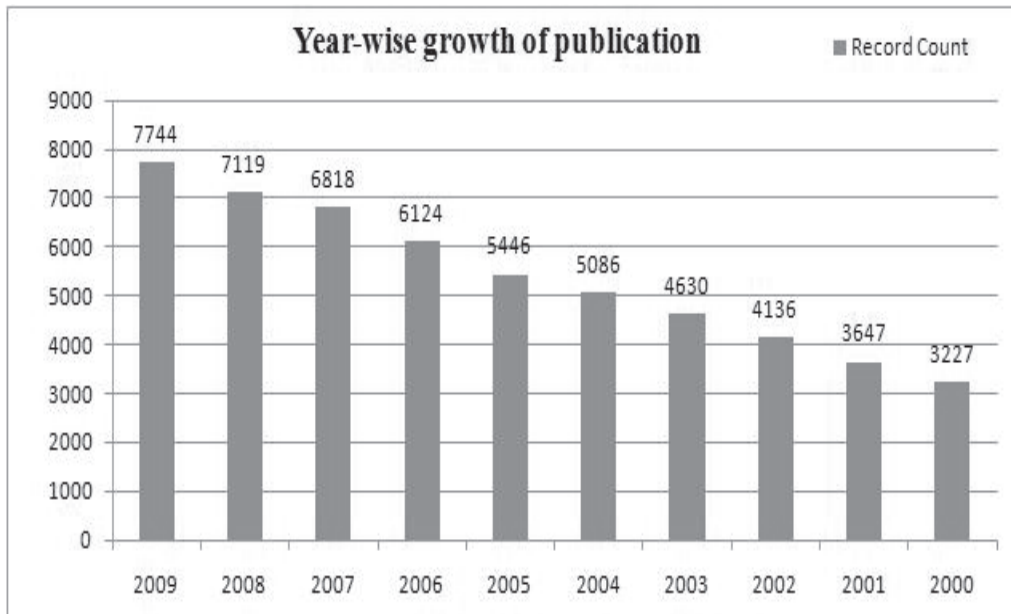
Here, an attempt was made to calculate the scholarly publication in the form of during the period of ten years from 2000-2009. Table-2 and Graph-2 present the year-wise distribution of number of articles indexed in SCI- Expanded database.

The average number of article publication was 5397.7 articles per year. It has been seen a gradual growth of Indian research output in chemistry from 2000 onwards. In the study, the contribution of earlier five years (2000-2005) was less than the average publications per year. Out of 53,977 articles,

7,744 (14.35%) articles were published in 2009 and 3,227 (5.98%) articles were in 2000, which are highest and lowest in ten years respectively.

**Table 2: Year-wise Distribution of Publication**

Sl. No.	Publication Year	Record Count (No. of articles)	Percentage (%) of 53977
1	2009	7744	14.35%
2	2008	7119	13.19%
3	2007	6818	12.63%
4	2006	6124	11.35%
5	2005	5446	10.09%
6	2004	5086	9.42%
7	2003	4630	8.58%
8	2002	4136	7.66%
9	2001	3647	6.76%
10	2000	3227	5.98%
<b>Total</b>	-	<b>53977</b>	<b>100.00%</b>



**Figure 2: Year-wise Growth of Publications**

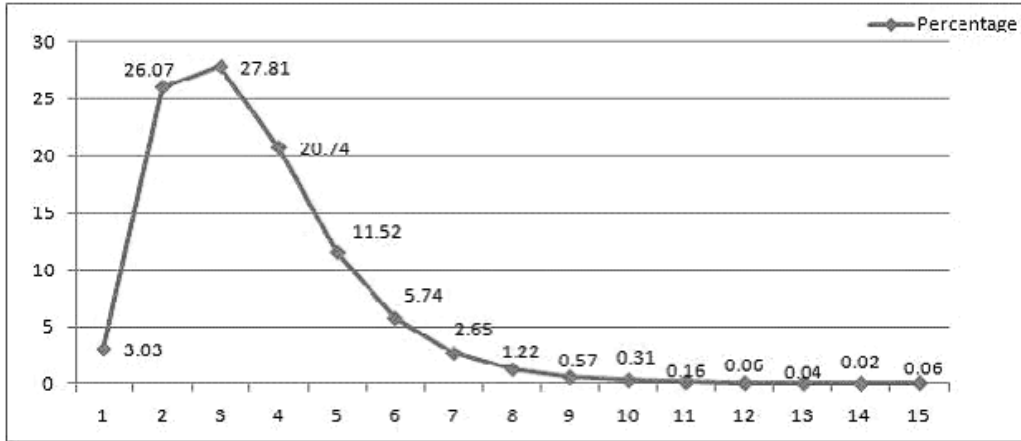
### 4.3 Authorship Patterns

Authorship pattern of the articles is presented in the Table-3. The study reveals that a total of (1, 91,466) authors have contributed the 53,977 articles leaving the frequencies of author. The average number of authors per article found to be 3.55.

**Table 3: Authorship Pattern**

Sl. No.	No. of Authors (Unit)	No. of Articles	Total No. of Authors	Percentage (%) of Articles	Percentage (%) of Authors	Cum. % of Articles
1	Single	1634	1634	3.03	0.85	3.03
2	Two	14070	28140	26.07	14.70	29.1
3	Three	15009	45027	27.81	23.52	56.91
4	Four	11193	44772	20.74	23.38	77.65
5	Five	6219	31095	11.52	16.24	89.17
6	Six	3100	18600	5.74	9.71	94.91
7	Seven	1433	10031	2.65	5.24	97.56
8	Eight	658	5264	1.22	2.75	98.78
9	Nine	310	2790	0.57	1.46	99.35
10	Ten	165	1650	0.31	0.86	99.66
11	Eleven	87	957	0.16	0.50	99.82
12	Twelve	35	420	0.06	0.22	99.88
13	Thirteen	20	260	0.04	0.14	99.92
14	Fourteen	13	182	0.02	0.10	99.94
15	Fifteen +	31	644	0.06	0.34	100
<b>Total</b>		<b>53977</b>	<b>191466</b>	<b>100</b>	<b>100</b>	

Among 53,977 articles, 1,634 (3.03%) articles are written by single author and 52,343 (96.97%) articles are written by two or more authors. Three-authored articles comprised highest percentage (27.81%), following two-authored articles (26.07%) of the total 53,977 articles. The authorship pattern reveals a remarkable difference between the number of single author and multiple authors. Very less number of articles are written by single author. Thus, the study reveals that multiple-authorship research is predominant as compare to solo in case of chemistry subject in India. The study opined that team research is favored in chemistry in India.



**Figure3: Authorship Trend**

The maximum number of papers are written by either two (26.07% articles), three (27.81% articles) or four authored (20.74% articles). Thus, we can say it as a decreasing trend in the number of authors in terms of team or group research as outlined in Graph-3. The sliding graph shows that the decreasing trends in the number of authors in terms of team or group research with respect to more than five authors.

#### 4.4 Degree of Author’s Collaboration

Various methods have been proposed to calculate the degree of research collaboration. Here, in this study the formula proposed by Subramanyam (1983) has been used.

$$\text{The degree of collaboration } C = \frac{NmNm}{Nm + Ns}$$

Where, C = Degree of collaboration in a discipline

Nm = number of multi-authored papers in the discipline

Ns = number of single-authored papers in the discipline

Here, Nm = 52343

Ns = 1634

$$C = \frac{52343}{52343 + 1634} = 0.03 \quad \text{Thus, the degree of collaboration (C) is 0.03}$$

So, in the study the degree of collaboration during the overall 10 years (2000-2009) is 0.03. But, when we calculate the year-wise degree of collaboration for 10 years, the results arise different. The Table-4 represents the year wise number of multi-authored articles and their degree of

collaboration. In the study, the degree of collaboration of all years is almost same of the mean value as 0.97.

**Table -4: Year Wise Degree of Collaboration**

Year	Total No. No. of Articles	Total No. No. of Authors	No. of Single Authored Articles	% of Articles	No. of Multi Authored Articles	% of Articles	Degree of Collaboration
2009	7744	29516	156	0.29	7588	14.06	0.98
2008	7119	26317	187	0.35	6932	12.84	0.97
2007	6818	24944	190	0.35	6628	12.28	0.97
2006	6124	21962	181	0.34	5943	11.01	0.97
2005	5446	19173	159	0.29	5287	9.79	0.97
2004	5086	17502	165	0.31	4921	9.12	0.97
2003	4630	15708	159	0.29	4471	8.28	0.97
2002	4136	13995	135	0.25	4001	7.41	0.97
2001	3647	11997	158	0.29	3489	6.46	0.96
2000	3227	10352	144	0.27	3083	5.71	0.96
<b>Total</b>	<b>53977</b>	<b>191466</b>	<b>1634</b>	<b>3.03</b>	<b>52343</b>	<b>96.97</b>	<b>0.97 (Mean)</b>

The analysis of Table -4 shows that in the 10 years of period, the multi authorship articles are higher and predominant on single authorship. The single authored articles are also almost same in all years. The multi authored articles 7588 (14.06%) are highest in the year 2009. It is seen that the multi authorship trend is increasing gradually in Indian chemistry research.

## 5. Conclusion

The authors studied year-wise growth of Indian scholarly output in chemistry; their authorship trend and the degree of collaboration. A gradual growth of Indian research output in chemistry is observed. The average number of authors per article is 3.55. The mean value of year-wise degree of collaboration for 10 years is 0.97. The year-wise degree of collaboration for 10 years is almost as same as the mean value 0.97 but, the degree of collaboration during the overall 10 years is 0.03. The single author publication of articles is very less with 1634 (3.03%) articles. The authorship pattern reveals a remarkable difference between the number of single author and multiple authors. The study concludes that multiple-authorship research is predominant as compare to solo in case of Indian research in chemistry.

Authors conclude by quoting, Arora and Pawan (1995), "Increase in multiple authorship and collaboration between researchers is an indication of growing professionalism in different fields. The collaboration and team work are among the most important necessities of scientific and technological work today."

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