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Research Productivity of Indian Institute of Toxicology Research (IITR): A Scientometric Analysis

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ABSTRACT: The present study analyses the research output of the Indian Institute of Toxicology Research (IITR) for the period of 25 years (1993 to 2017). The study emphasizes on the various characteristics of the publications such as highly cited papers, national & international collaboration profile, Degree of Collaboration, most prolific authors, most preferred journals for communication, citation impact of the publications, most frequently used author keywords. The Web of Science, a multidisciplinary bibliographic database was used to retrieve the data for the study. The scientists of IITR preferred to publish in the foreign journals. No journal in which the research works of IITR scientists were published belonged to India. 5.73% of the total publications remained uncited. Only 0.86% of the total publications were contributed by the single authors and rest of the 99% publications were contributed by multiauthors in collaboration. The 13% of the total publications were internationally collaborated and 86% of them were domestically collaborated. The Oxidative Stress, Apoptosis, DNA Damage and Lipid Peroxidation were found to be the most active research areas as per the analysis of keywords of authors.

Keywords: Scientometrics, Bibliometrics, Indian Institute of Toxicology Research, IITR, Research Productivity, Toxicology.

1. INTRODUCTION

A research in the field of Toxicology is essential to understand the various hazardous and toxic effects of the chemicals, pesticides, environmental pollutants, food adulterants, drugs, nanomaterials and to develop safety measures in all perspectives. One of the newly born disciplines of the toxicology is Toxicogenomics. It deals with how various genes in the genome respond to the various toxicants and how these toxicants modify the function and expression of

the genes in a genome (Patel et. al., 2005). The present study analyses the research output of the Indian Institute of Toxicology Research (IITR), Lucknow.

The Indian Institute of Toxicology Research (IITR), a constituent laboratory of the Council of Scientific and Industrial Research (CSIR) was established in the year 1965. It undertakes the research in the areas of Food, Drug and Chemical Toxicology, Environmental Toxicology, Regulatory Toxicology, Nanotherapeutics & Nanomaterial Toxicology, Systems Toxicology & Health Risk assessment. The institution's research contribution in the field of Toxicology has positioned the CSIR globally among the top five institutions in the areas of Food, Industrial, Nanomaterial Toxicology. The unique feature of the institute is that it is the only institute to have the high performance Computational Toxicology facility in India. Computational Toxicology involves investigating the interactions of the chemical agents with the biological organisms at molecular and cellular level.

The government being accountable to the general public for the expenditure of the public fund, it is essential to know whether the allotted funds for research have been utilised properly by the respective institutions. Thus, there is a necessity to analyse the performance of the government funded research institutions using various performance indicators (Martin, 1996). As a result of Research and Development in all the subjects, new scientific areas are emerging every now and then which will directly lead to the scarcity of budget. The CSIR is one of the world's largest publicly funded R&D organisations. Hence, it is important to study the output of the institutions in terms of their research publications. Therefore, the present study is conducted to analyse the research productivity of the IITR, a constituent body of the CSIR.

2. REVIEW OF LITERATURE

Mini Devi and Lekshmi (2014) analyse the research output of the Jawaharlal Nehru Tropical Botanical Garden Research Institute (JNTBGRI), Thiruvananthapuram. The authors used the annual reports of the JNTBGRI as the source of data to analyse the research output for the period from 2001 to 2010. The findings of the study reveal that the scientists of the JNTBGRI preferred to publish their papers in the Indian journals. The *Journal of Taxonomic Botany* was found to be the most productive journal, followed by *Zoos Print Journal*. The scientists published most of their research works in the field of Botany, followed by Conservation Biology.

Varghese and Rajan (2009) examine the productivity of scientists of Rajiv Gandhi Centre for Biotechnology (RGCB), Thiruvananthapuram. The analysis of 632 publications contributed by the scientists of the RGCB for the period from 1995 to 2006 revealed that the scientists' productivity showed a positive growth trend both qualitatively and quantitatively. Gupta et al. (2014) analyse the top 110 highly productive Pharmaceutical organizations in India for the period from 2008 to 2012. The authors used Scopus as the source database for retrieving the data. The authors identified that the model of funding for research in the universities, national institutes, research institutes was effective in producing quantitative & qualitative research. On the other hand, the model of funding for research in pharmacy schools, hospitals, industrial firms was comparatively less effective. Therefore, the authors suggest to develop an institutional mechanism at the national level to manage and coordinate the research activities in the field of Pharmaceutical research in India.

Gupta et al. (2011) conducted a study on the ranking of the most productive pharmaceutical organizations in India. The Scopus database was used as the source database for retrieving the data for the period from 2001 to 2009. Twenty four organizations were found to be highly productive. The Indian Institute of Chemical Technology, Hyderabad topped the list in terms of high quantity and quality publications, i.e. h-index and p-index. Kaur and Mahajan (2012) conducted a comparative study on the research output of two leading health care institutions viz., the All India Institute of Medical Sciences (AIIMS), New Delhi and the Post Graduate Institute of Medical Education and Research (PGIMER), Chandigarh. The authors used Scopus as the source for obtaining the data for the period from 1999 to 2008. The AIIMS had more number of publications. The study found that except in terms of publications, both the institutes were similar in terms of quality of papers, h-index and international collaborative papers.

3. OBJECTIVES

The main objective of the present study is to analyse the research output of the IITR for the period from 1989 to 2017 using various qualitative and quantitative indicators. The specific objectives are to:

- analyse the growth of publications and the citation impact;
- find out the most preferred journals for publication by the scientists;
- ascertain the countrywise distribution of journals & publications;
- identify the most prolific authors;

- determine the collaboration pattern of the authors;
- study the citation pattern & identify the most highly cited papers and
- ascertain the frequently used keywords by the authors.

4. METHODOLOGY

The Scopus and Web of Science are the two most widely popular databases used for conducting the bibliometric analysis. The present study uses the Web of Science, a multidisciplinary, bibliographic database for the retrieval of data. The data was downloaded for a period of 25 years (1993 to 2017). The string used for the retrieval of data was OO=(Indian Institute of Toxicology Research), PY=1993-2017 and the search was restricted to the Science Citation Index. The data was further analysed using the MS-Excel software. The Vosviewer software was used for the data visualization. The Vosviewer is a computer program for Visualizing bibliometric maps of science developed by Van Eck and Waltman (2010). Various qualitative and quantitative indicators were used for the analysis of the research output which include Total number of Publications (TP), Total number of Citations (TC), Citations Per Paper (CPP), h-index, Impact Factor of the journal (IF), Publications Not Cited (PNC), Domestic Collaboration Index (DCI), International Collaboration Index (ICI) and Degree of Collaboration (DC). The study does not analyse the research contributions of the IITR scientists which may be published in the sources not covered by the Web of Science.

5. ANALYSIS AND INTERPRETATION

Table 1. Productive institutions in the field of Toxicology in India

Rank as per TP	Name of the Institution	TP	TC	ACPP	h-index
1	Indian Institute of Toxicology Research, Lucknow	730	15426	21.13	56
2	University of Madras, Chennai	369	7110	19.27	44
3	Jamia Hamdard University, New Delhi	295	6279	21.28	41
4	Annamalai University, Chidambaram	277	5949	21.48	41
5	University of Calcutta, Calcutta	227	3850	16.96	33
6	Defence Research Development Establishment, Gwalior	210	4557	21.7	37
7	Banaras Hindu University (BHU), Varanasi	198	3826	19.32	28
8	Bhabha Atomic Research Centre (BARC), Mumbai	197	3831	19.45	33
9	Aligarh Muslim University, Aligarh	196	4480	22.86	33
10	Panjab University, Chandigarh	187	2984	15.96	28
	Total output (1993-2017)	9133	1,50,687	16.50	-

A total of 9,133 publications were contributed by several institutions of India in the field of Toxicology for the period from 1993 to 2017 which received 1,50, 687 citations. The table 1 shows the productive institutions with their publication output and the impact of the publications. Among the top ten individual institutions, seven were universities and three were research institutions. The Indian Institute of Toxicology Research (IITR) topped the list with 8% share of total publications which received 10.24% of the total citations. Although, the University of Madras ranked second as per the number of publications, the citation per paper was higher for the publications of Aligarh Muslim University. The present study analyses the research output of the Indian Institute of Toxicology Research, Lucknow.

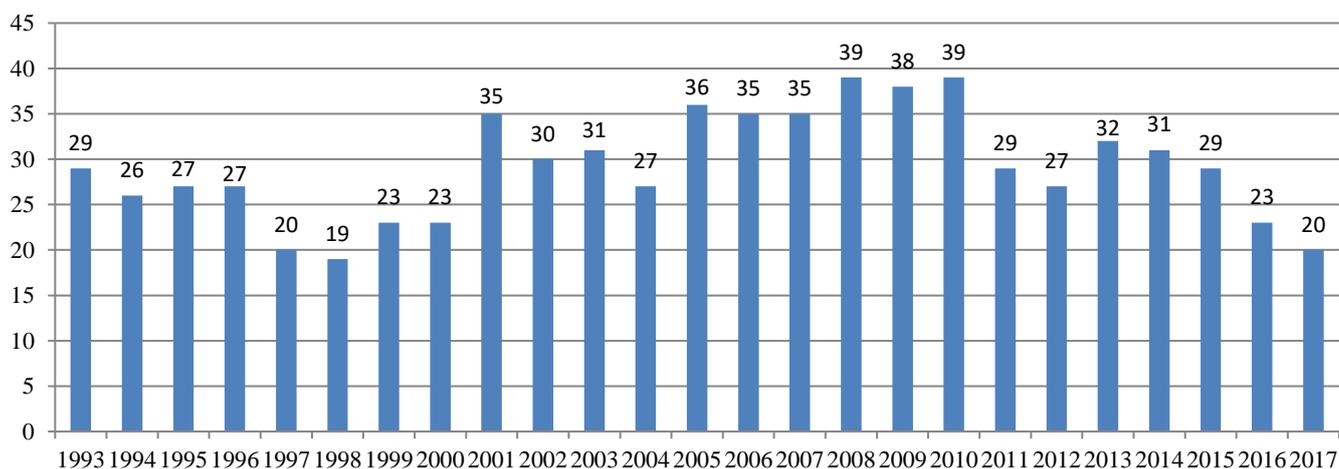


Figure 1- Yearwise research output of IITR

The figure 1 shows the pattern of growth of research output of the IITR for the period of 25 years from 1993 to 2017. It can be observed from the figure 1 that the research output was non linear for the initial years (1993 to 2007) of study. The publications reached its peak in the years 2008 and 2010 and thereafter gradually decreased. The number of publications were the lowest (19) in the year 1998 . The IITR Scientists’ research output was classified into 27 subject categories in the Web of Science. This shows the multidisciplinary nature of the Toxicology field. The dominant research areas to which the scientists of the IITR contributed were Environmental Sciences with 199 publications, followed by Pharmacology and Pharmacy (137), Food Science Technology (66), Genetics Heridity (66), Biotechnology and Applied Microbiology (36), Public, Environmental and Occupational Health (30).

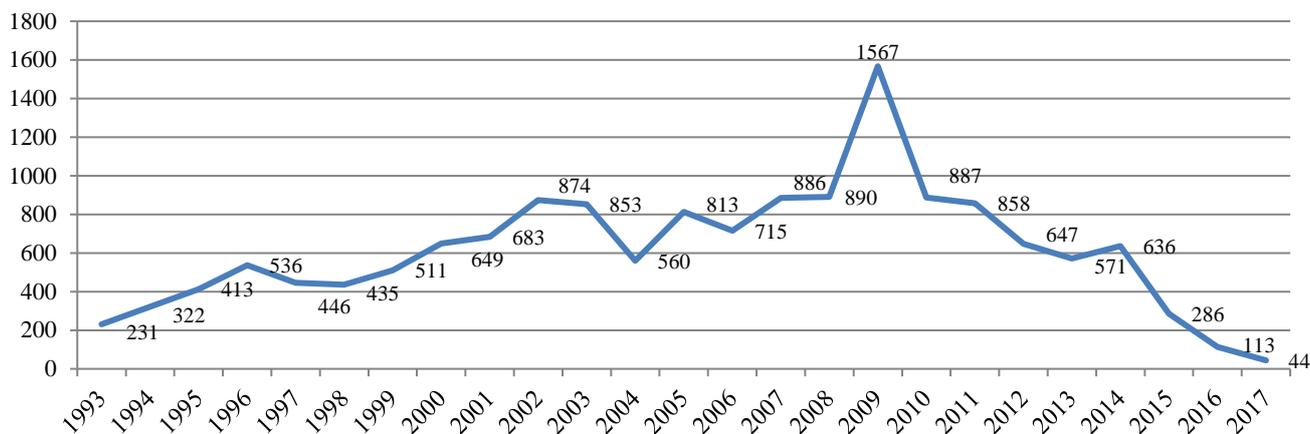


Figure 2- Yearwise citation impact of research output of IITR

Table 2. Citation frequency of IITR Publications

Number of citations	Number of Publications	Total citations	Number of citations	Number of Publications	Total citations
0	37	0	21-30	92	2301
1	26	26	31-40	50	1743
2	29	58	41-50	26	1161
3	35	105	51-75	36	2169
4	30	120	76-100	14	1209
5	37	185	101-200	13	1736
6-10	138	1102	201-300	3	748
11-20	163	2443	>300	1	320
Total	-	-	-	730	15426

The figure 2 presents the yearwise citation distribution of the research publications. The citations were the highest for the year 2009 and showed a gradual decline for the remaining period. A total of 730 publications have been contributed by the IITR which received 15,426 publications during the period from 1993 to 2017. The average citations per paper was 21.13. The citation analysis revealed that 5.07 percent of the total publications remained uncited. The table 2 shows that about 21.50% of the publications received citations in between 1-5. The proportion of publications that received citations in the range of 11-20 was 22.33 percent. After that, the number of publications gradually declined with an increase in citation frequency. Only 2.33% of the total output received citations ≥ 100 . Overall, the citation distribution as per the citation range shows that 78 percent of the total research output had received six or more than six citations each.

Table 3. The highly preferred journals by the scientists of IITR

Rank	Name of the journal	Country of origin	TP (%)	FPY-LPY	TY	IF
1	<i>Bulletin of Environmental contamination and Toxicology</i>	USA	67 (9.18)	1993-2012	20	1.412
2	<i>Toxicology Letters</i>	Ireland	58 (7.95)	1993-2017	25	3.858
3	<i>Food and Chemical Toxicology</i>	England	54 (7.4)	1993-2017	25	3.778
4	<i>Human & Experimental Toxicology</i>	England	48 (6.58)	1993-2016	24	1.802
5	<i>Ecotoxicology and Environmental Safety</i>	USA	35(4.8)	1996-2015	20	3.743
6	<i>Toxicology and Applied Pharmacology</i>	USA	28(3.84)	2004-2016	13	3.791
7	<i>Toxicology</i>	Ireland	24(3.29)	1994-2017	24	3.582
8	<i>Environmental Toxicology and Pharmacology</i>	Netherlands	22 (3.01)	1997-2017	21	2.313
9	<i>Journal of Applied Toxicology</i>	England	22 (3.01)	1994-2015	22	3.159
10	<i>Toxicology In Vitro</i>	England	21 (2.88)	2001-2014	14	2.866

FPY-First Publication Year, LPY-Last publication Year, TY-Total Year, IF-Impact Factor

The journals are the primary source of publication which keep the scholarly community updated with the current research and development in a field. The 730 publications are scattered over a total of 75 journals. The table 3 shows the highly preferred journals by the IITR scientists to publish their research works. Among the top ten journals, four journals are published from England, three from USA, two from Ireland, and one is published from Netherlands. The study shows that the scientists from the IITR preferred to publish their papers in the foreign journals rather than in the Indian journals. 51.92 percent of the total research output was published in these ten productive journals. The other publications were scattered among the other 65 journals. The impact factor of the journals listed in the table reveals that the IITR scientists publish their research works in the high impact factor journals and the publications have international visibility.

Table 4. Country-wise distribution of highly preferred Journals

Rank as per TP	Country of origin	No. of Journals	Number of publications	% of Publications
1	USA	32	286	39.18
2	England	22	242	33.15
3	Ireland	3	98	13.42
4	Netherlands	12	80	10.96
5	Japan	2	11	1.51
6	Germany	2	8	1.09
7	Denmark	1	4	0.55
8	Croatia	1	1	0.14
	Total	75	730	100

The 730 publications contributed by the IITR were scattered over 75 journals. The analysis of countrywise distribution of the journals in which the scientists of IITR have published their works revealed that the highest percentage of (39.18) of the total publications of the IITR were published in journals of USA followed by, England with 33.15%. No journal in which the research works of scientists of the IITR were published belonged to India. It shows the preference of the scientists of the IITR to publish in foreign journals. It was identified that though, only three journals emanated from Ireland, they published 13.42 percent of the total publications which was more than the proportion of documents (10.96) published in the twelve journals of Ireland origin. Scientists of the IITR published 72.33 percent of their research works in the journals published from USA and England. The remaining publications were scattered in the journals published from Ireland, Netherlands, Japan, Germany, Denmark and Croatia. Overall, 99.86 percent of the contributions of the scientists of the IITR were published in the journals originating from the developed countries which may be considered as a good sign of research quality.

Table. 5 Distribution of research output according to Impact Factor

Quartile	Category Value (IF)	Number of publications	% of Publications
Q1	Low (1.25)	15	2.05
Q2	Medium (1.9)	208	28.5
Q3	High (3.17)	176	24.11
Q4	Very High (>3.17)	278	38.08
	IF not available	53	7.26
	Total	730	100

The Impact factor reflects the prestige and quality of a journal. The IF is not only used to measure the quality of a journal, it is also used to evaluate an individual researcher, department or an institution by considering in which journals they opt to publish their research works (Moed, 2005). The total publications were classified into four quartiles for the purpose of analysis (Dutt and Nikam, 2013). The distribution is presented in the table 5. The distribution of the publications according to the impact factor of journals reveals that the 91 percent of the research publications of the scientists of the IITR is published in the medium, high and very high Impact Factor journals. This implies that the research works published by the scientists of the IITR have higher visibility and the works are related to the global research trends in the field of Toxicology.

Table 6. Blockwise collaboration pattern of publications

Five year Block period	Single authored publications	Domestically collaborated publications	Internationally collaborated publications	Total Publications	Nature of collaboration	
					DCI	ICI
1993-1997	3	120	6	129	108	38
1998-2002	0	101	29	130	91	169
2003-2007	2	147	15	164	106	69
2008-2012	1	141	30	172	95	131
2013-2017	0	119	16	135	102	92
Total	6	628	96	730	-	-

DCI-Domestic Collaboration Index, ICI-International Collaboration Index

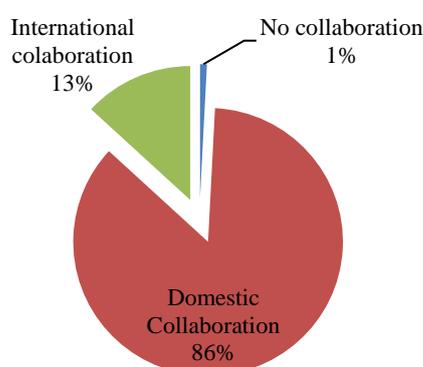


Figure 3 – Collaboration wise distribution of IITR research output

The nature of collaboration was identified by analysing the institution address. The collaboration is said to be domestic if the authors from several institutions or from the different departments within the institution collaboratively involve in the research work. If one of the institution addresses belonged to foreign country then the collaboration is classified as international (Bordons et al., 1996). The Domestic Collaboration Index (DCI) and International Collaboration Index (ICI) given by Garg and Padhi (2001) were used in the present study. The blockwise research output shows that there is a steady increase in the number of publications. There were no single authored publications during the second and fifth block. The figure 3 depicts the collaboration wise classification of research output. Less than one percent (0.82%) of the total publications were produced by single authors. The highest proportion (86.02 %) of documents were produced as a result of domestic collaboration. During the first, third and fifth block, the domestic collaboration activity dominated over the international collaboration. Whereas, for the second and fourth block, the international collaboration activity dominated over the domestic

collaboration. Overall, the domestic collaboration activity was more than the international collaboration.

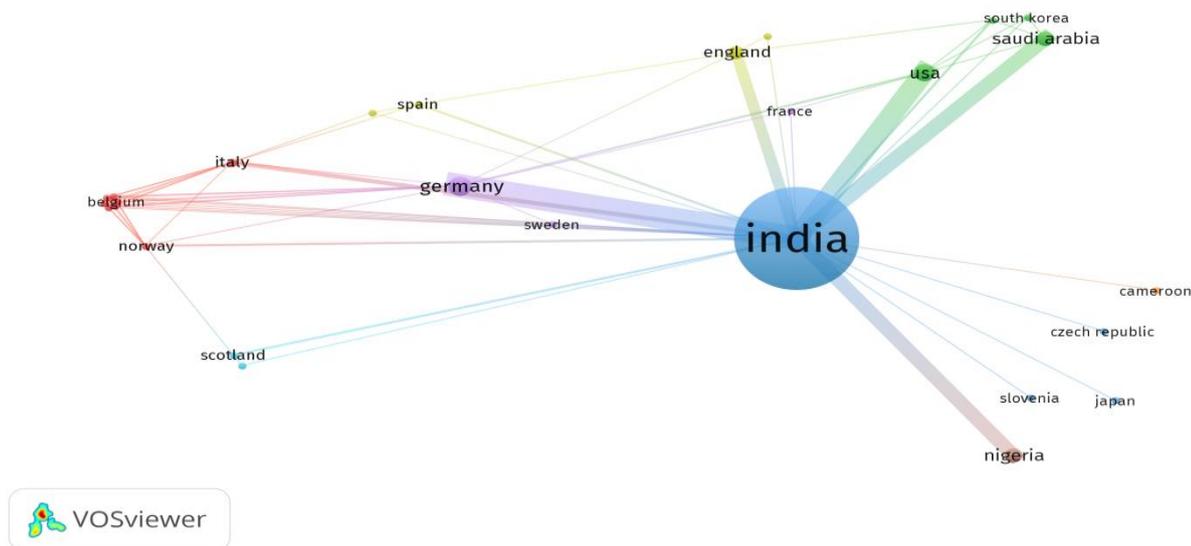


Figure 4 - Collaborative countries of IITR

The figure 4 shows the network of the countries with which the scientists of the IITR have published in collaboration. Thirteen percent of the total output was produced as a result of co-authorship with the foreign country. The stronger links between the countries represent the number of collaborated publications. The scientists of the IITR worked in collaboration with co-authors from 27 countries other than India. The USA topped the list with 4.11% collaboration, followed by, the Germany with 3.014% of the internationally collaborated publications. The Indian scientists published major portion of their international collaborated works with the USA, Germany, Saudi Arabia, Nigeria and England.

Table 7. Most prolific authors of IITR

Rank	Author name	TP (%)	TC	CPP	PNC	h-index
1	Dhawan, Alok	61 (8.36)	2690	44.10	6	29
2	Das, Mukul	60 (8.22)	1224	20.40	2	17
3	Parmar, Devendra	56 (7.67)	1574	28.11	5	21
4	Saxena, Daya	44 (6.03)	1350	30.68	1	23

	Krishna					
5	Mathur, Neeraj	39 (5.34)	1372	35.18	1	23
6	Pant, Aditya B.	38 (5.21)	709	18.66	4	16
7	Seth, P K	38 (5.21)	966	25.42	1	19
8	Rahman Q	35(4.80)	950	27.14	2	15
9	Chowdhuri D K	32 (4.38)	934	29.19	2	21
10	Singh K P	31 (4.25)	391	12.61	2	13
11	Khanna V K	30 (4.10)	540	18.00	5	12

TP-Total number of Publications, TC-Total number of Citations, CPP-Citations Per Paper PNC-Publications Not cited

In the present study, the authors with contribution of ≥ 4 percent of the total publications were considered as the prolific authors. A total of 882 authors published 730 publications for the period of 20 years. The table 7 shows the ranking of authors as per their number of publications. The author Alok Dhawan topped the list with 8.36% of the total research output, followed by, the author Mukul Das with 8.22% publications. As per Citations Per Paper, the publications of the author Mathur Neeraj had the second highest citations per paper value (35.18), followed by Dayakrishna Saxena with the third highest CPP (30.68).

Table 8. Blockwise authorship pattern of Publications

Five Year Blocks	Single authored publications (%)	Two authored publications (%)	Multi authored publications (%)	Mega authored publications (%)	Total	DC
1993-1997	3	18	76	32	129	0.98
1998-2002	0	27	71	32	130	1.00
2003-2007	2	31	72	59	164	0.99
2008-2012	1	13	61	97	172	0.99
2013-2017	0	8	43	84	135	1.00
Total	6	97	323	304	730	0.98

Multi-3&4 authored publications, Mega- >4 authored publications

The authorship pattern of the IITR publications is presented in Table 8. The Toxicology subject being highly interdisciplinary in nature, it requires vast knowledge and expertise of diverse fields and it is difficult to be acquired by a single author. So, the multi authors having expertise in various interdisciplines of Toxicology across the globe collaboratively participate in the research works. Therefore, the multi & mega authored publications constituted 85.89% of the total publications. Whereas, only 0.82% of the total publications were contributed by the single authors, and the single authored publications show a decreasing trend over the first to last block period. On the other hand, the mega authored publications show a steady increase from the first block (4.38%) to fourth block (13.28%). The Degree of Collaboration given by Subramanyam (1983) was used to measure the collaboration. The DC was found to be maximum (100%) during

the second and fifth block. This shows that the scientists preferred to work in teams and if the trend continues, the solo authored works may become extinct in near future.

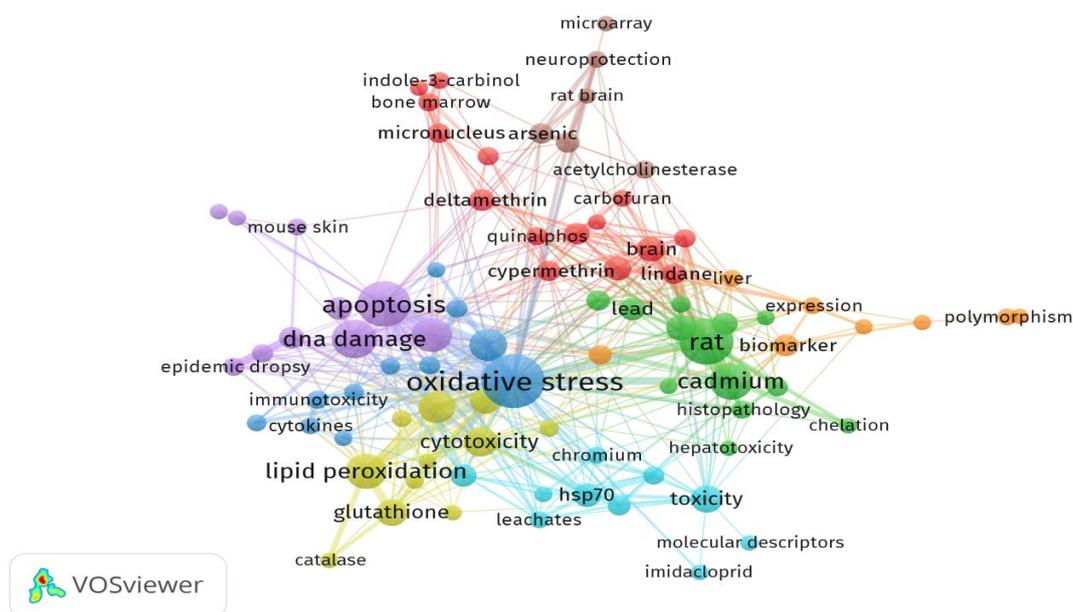


Figure 5 Author Keyword Co-occurrence Map

The map was generated based on the author keywords. Out of the total 1621 keywords, 84 met the threshold. The threshold value chosen was 5 i.e. the keyword must occur atleast five or more than five times in the author keyword. The larger the circle, the more frequent the occurrence of the particular term in the keywords given by the author. The links between the keywords represent how oftenly those words appear together. Oxidative stress keyword occurred 64 times followed by rat which appeared 46 times and apoptosis with 45 times frequency. The different coloured group of words represent clusters and they represent the words relating to a specific research area. The closer the keywords located in the map, the higher the co-occurrence of those terms. Apoptosis is the process of programmed cell death in muticellular organisms and oxidative stress is one of the reasons for the cell death. These keywords represent the research tendency of the scientists of the IITR.

Table 9. Highly cited Publications of IITR (≥ 150 citations)

Rank	Bibliographic details	Times cited	Country collaboration	Author(s) in byline	Document type
1	DNA damaging potential of Zinc oxide nanoparticles in human epidermal cells. <i>Toxicology Letters</i> . (2009). Vol.185 (3): p. 211-218	320	India	6	Article
2	Cancer preventive properties of ginger: A brief overview	274	India	2	Review
3	Evidence that ultrafine titanium dioxide induces micronuclei and apoptosis in Syrian hamster embryo fibroblasts. <i>Environmental Health Perspectives</i> . (2002). Vol. 110 (8): p. 797-800	260	India, Germany	7	Article
4	ROS-mediated genotoxicity induced by titanium dioxide nanoparticles in human epidermal cells. <i>Toxicology In Vitro</i> . Vol. 25 (1): p. 231-241	214	India	6	Article
5	Comet assay: a reliable tool for the assessment of DNA damage in different models. <i>Cell Biology and Toxicology</i> . Vol. 25 (1): p. 5-32	199	India	3	Review
6	Stability constants of metal-humic acid complexes and its role in environmental detoxification. <i>Ecotoxicology and Environmental Safety</i> . Vol. 47 (2): p. 195-200	175	India	3	Article
7	Mechanisms of genotoxicity. A review of in vitro and in vivo studies with engineered nanoparticles. <i>Nanotoxicology</i> . Vol. 8 (3): p.233-278	163	Norway, India, Scotland	6	Review
8	Induction of oxidative stress, DNA damage and apoptosis in mouse liver after subacute oral exposure to zinc oxide nanoparticles. <i>Mutation Research- Genetic Toxicology and Environmental Mutagenesis</i> . Vol. 745 (1-2): p.84-91	159	India	4	Article

The documents which were cited more than 150 times in other works were considered as highly cited publications. The table 9 shows the bibliographic details of the highly cited documents along with the details of the country collaboration, number of authors and document type. The author affiliation details were analysed to find the country collaboration. Among the highly cited documents three of them belonged to the document type i.e. Review, and five were articles. Only two of the highly cited publications were internationally collaborated. All the highly cited publications were multi authored and no document was contributed by a single author. The scientists from the IITR involved in research with many of the developed as well as developing countries all over the world. The document type distribution of the IITR publications revealed that the articles constituted the major proportion i.e 92.60% of the total publications, followed by the Review articles (23; 3.15%) and Meeting abstracts (20; 2.74%). The review articles received 1431 citations with average Citations Per Paper for the review articles was 62.22, whereas, the CPP for the articles was 20.68. The average Citations Per Paper for the review articles was much higher than those of the original articles.

6. CONCLUSION

The present study which was based on 25 years of data (1993-2017) indicates that the IITR's research output gained an impetus during the last decade i.e., 2006-2017. The IITR is the most productive institution in the field of Toxicology in India. Flora (2008) explains that the well structured education in India in the field of Toxicology at university level is lacking. However, the present study revealed that seven universities were figured to be in the top ten productive institutes in India in the field of Toxicology. Scientists of the IITR have published papers in collaboration with the authors belonging to 27 universities in India. The eight universities were identified as the prominent collaborators with more than five publications produced in collaboration with the scientists of the IITR. The prominent collaborating universities include, Jamia Hamdard University, New Delhi and King George Medical University, Lucknow with the highest (31) number of collaborative publications each followed by University of Lucknow (30), Banaras Hindu University, Varanasi (17) and Ahmedabad University, Ahmedabad (14). Almost 99% of the total output emerged as a result of collaborative activity. Out of the collaborated publications, 13% of them were internationally collaborated and 86% of the publications were domestically collaborated.

The research collaboration gained momentum especially for the block period 1998-2002 & 2013-2017 during which the Degree of Collaboration was 100%. The highest (39.18%) percentage of the total publications were published in the journals originating from the USA and no single journal in which the IITR scientists published their research works belonged to India. This shows the preference of the IITR scientists to publish their works in the journals of foreign origin rather than India. The works were published in the journals having medium, high and very high impact factor journals which implies that the publications of the IITR scientists are having international visibility. The Oxidative Stress, Apoptosis and DNA Damage were the most frequently used author keywords.

The scientists of the IITR worked in collaboration with many of the developed and developing countries. However, the more dominant collaborative linkage was with the USA and Germany. The CPP for the publications of the IITR scientists produced in international collaboration (27.48) was higher than those of the domestically collaborated publications (20.21). Within the document types, the CPP for review articles was two times higher (62.22) than that of the original articles (20.68). The review articles are having tendency to receive more citations (Vanclay, 2013) and internationally collaborated publications tend to increase the citation rate as

compared to purely domestic collaborated publications (Moed, 2005). It is evident from the study that only 13% of the total publications were internationally collaborated and 3.15 percent of the total publications were review articles. The IITR's research productivity in terms of number of publications is lesser than the other institutions at global level. Hence, it is suggested to the scientists of the IITR to make efforts to contribute more number of works in international collaboration and review articles as it will result in the increase of global visibility of the institution.

REFERENCES

- Bordons, M., Gomez, I., Fernández, M., Zulueta, M., & Mendez, A. (1996). Local, domestic and international scientific collaboration in biomedical research. *Scientometrics*, 37(2), 279-295.
- Dutt, B., Nikam, K. (2013). Solar cell research in India: A scientometric profile. *Annals of Library and Information Studies*. 60, 115-127.
- Flora, S. J. (2008). Status of Toxicological research in India. *Chemical Research in Toxicology*, 21 (7), 1317-1319.
- Garg, K. C., & Padhi, P. (2001). A study of collaboration in laser science and technology. *Scientometrics*, 51(2), 415-427.
- Gupta, B. M., Kaur, H., & Bala, A. (2011). Ranking of Indian pharmaceutical institutions for their research performance during 2000-2009. *International Journal of Pharmaceutical Applications*, 2(1), 99-104.
- Gupta, R., Ahmed, K. M., & Gupta, B. M. (2014). High Productivity Pharmaceutical Organizations in India: A Study of their Performance in terms of Quantitative Indicators, 2008-12. *Journal of Young Pharmacists*, 6(2), 4.
- Kaur, H., & Mahajan, P. (2012). Comparative Evaluation of Research Output: AIIMS Vs PGIMER. *DESIDOC Journal of Library & Information Technology*, 32(6).
- Leydesdorff, L., & Felt, U. (2012). Book and book chapter in the book citation index (BKCI) and science citation index (SCI, SoSCI, A&HCI). *Proceedings of the American Society for Information Science and Technology*, 49(1), 1-7.
- Mini Devi, B., & Lekshmi, V. (2014). Scientometric assessment of publication productivity of JNTBGRI, Thiruvananthapuram. *DESIDOC Journal of Library & Information Technology*, 34(2).

- Moed, H. F. (2005). Citation analysis of scientific journals and journal impact measures. *Current Science*, 89 (12), 1990-1996.
- Moed, H. F. (2005). Does International Scientific Collaboration Pay?. *Citation analysis in research evaluation*, 285-290.
- Patel, S., Parmar, D., Gupta, Y. K., & Singh, M. P. (2005). Review Articles-Contribution of genomics, proteomics, and single-nucleotide polymorphism in toxicology research and Indian scenario. *Indian Journal of Human Genetics*, 11(2), 61-75.
- Schlagberger (2017). Resume, Introduction to the Web of Science. Retrieved from https://www.biochem.mpg.de/5532855/NeuWeb_of_Science_Webinar
- Subramanyam, K. (1983). Bibliometric studies of research collaboration: A review. *Journal of Information Science*, 6(1), 33-38.
- Van Eck, N.J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523-538.
- Vanclay, J. K. (2013). Factors affecting citation rates in Environmental Science. *Journal of Informetrics*, 7(2), 265-271.
- Varghese, R. R., & Rajan, J. S. (2009). Productivity of scientists of Rajiv Gandhi Centre for Biotechnology (RGCB): an analysis. *Annals of Library and Information Studies*. 56, 156-162.