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## A Bibliometric Analysis of Pharmacy/Pharmacology Research in Pakistan

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### ABSTRACT

This study evaluates research carried out in Pakistan during 1975-2014 in the fields of pharmacy and pharmacology using different bibliometric indicators. The data have been retrieved from online database of the ISI Web of Science. The global share of Pakistan in the publications in the fields of pharmacy and pharmacology is only 0.25%. The volume and quality of research in pharmacology and pharmacy revealed a positive trend in Pakistan from 2005 onwards, as measured by the number of articles published in ISI-indexed journals. The average annual growth rate is 29.29% for publications and 34.22% for citations. If compared with Asian countries, 27 countries including Pakistan are ranked in top 100 publishing countries in the field of pharmacology/pharmacy by Web of Science. Out of those 27 countries, Pakistan holds 13th rank and still needs concrete measures to increase research productivity and visibility of researchers in the field of pharmacology/pharmacy.

**Key words:** Pakistan, pharmacy, pharmacology, bibliometrics

### INTRODUCTION

Research is elementary for the socioeconomic development of a country. Realizing the importance of scientific research, Pakistan is also making efforts to contribute towards knowledge production, transmission and transfer. Although, this share is modest but there is a rapid growth in scientific research activities in the country during the past decade and the quantity and quality of articles published in peer reviewed scientific journals is constantly increasing. This increase is mainly a result of the initiatives and inducements of the Higher Education Commission and the annual grant of award from the Pakistan Council of Science and Technology to active scientists, on the basis of their research productivity, particularly on publications in ISI-indexed Journals (Nasir and Ahmed, 2013).

It is difficult to quantify the scientific research directly but different bibliometric indicators are increasingly employed to evaluate the pattern of research performed by researchers, institutes and countries (Luukkonen, 1990; Taubes, 1993; Friedberg, 2000). A number of studies are available to measure the quantity and impact of scientific publications (Fu *et al.*,

2010; Sainte-Marie 2010; Han and Ho, 2011; Li *et al.*, 2011; Tanaka and Ho, 2011; Shi *et al.*, 2012; Liu *et al.*, 2012; Bilir *et al.*, 2013; Fu *et al.*, 2013; Gopalakrishnan and Kumar, 2013; Du and Tang, 2014).

The research in pharmaceutical/pharmacological sciences helps in progress of the country in health, industry, social and economic aspects (EFPIA., 2013). The pharmaceutical and pharmacological research encompasses all aspects of therapeutics, from design over experimental research to socio-economic components and entire drug discovery and development process. The role of pharmacists and pharmacologists in health care is increasing at a faster pace and they are the third largest healthcare professional group in the world. Currently, there are more than 6000 pharmacists (pharmacists are not necessarily scientists, as the health professionals with pharmacy is an undergraduate degree, whereas pharmacologists are the one who hold at least Master degree in pharmacology, while the basic degree could be with Pharmacy, Medicine; hence, we need to use the terminology carefully) and pharmacologist in Pakistan, but unfortunately their share to total publications is not laudable in comparison to other countries.

The present study focuses attention on the bibliometric analysis of publications in the area of pharmacological sciences from Pakistan for the period from 1975-2014. It aims to provide an insight in important aspects of publication output and international citation impact of the pharmacists and pharmacologists of Pakistan.

### MATERIALS AND METHODS

The present study attempts to find out the pattern of information published by researchers in the field of “pharmacology pharmacy” from Pakistan. The publication data in the field of pharmacy/pharmacology were extracted from online database of the Science Citation Index (SCI) retrieved from the ISI Web of Science, Philadelphia, PA, USA. The data retrieval date was March 01, 2015. The search option was run for country (Address = Pakistan) for time span 1975-2014. The records obtained were refined in the research domain = Science technology and then all records that were categorized as “pharmacology/pharmacy” among the ISI disciplines were retrieved. The data were analyzed according to number of publications, times cited, cites per document, most frequently cited articles, document type, most frequently used journals and international collaborations for pharmacology pharmacy research. A comparative analysis of records retrieved is carried out with top publishing countries as well as with other countries of the region in the field of pharmacology and pharmacy to know the scientific ranking of Pakistan in the research domain. The data retrieved was analyzed using GraphPad Prism (Version 3.02, GraphPad Software Inc, San Diego, CA, USA), a spreadsheet-based graphing and statistical software package.

### RESULTS AND DISCUSSION

In the time span of 1975-2014, a total of 65,647 articles were published from Pakistan in ISI-indexed journals, out of which 97.88% (64,254) were in different fields of Science and Technology. Over the period analyzed, a total of 3,351(5.22%)

papers were published from Pakistan that was categorized by ISI as belonging to the “pharmacology/pharmacy” discipline. Table 1 gives a detailed overview of publications with their citation details. The data retrieved from databases of the Web of Science show that a total of 1,363,257 publications in the research area of pharmacy and pharmacology have been published all over the world. The global share of Pakistan in the publications in the fields of pharmacy and pharmacology is only 0.25%.

**Year wise publications from Pakistan:** Year wise publications from Pakistan show a trend of rapid increase from 2005 onwards (Fig. 1). The citations for these papers also show a sudden increase in the same period. The Annual Growth Rate (AGR) was also calculated for publication output using the equation:

$$\text{Annual growth rate (\%)} = \frac{\text{Current year total} - \text{Previous year total}}{\text{Previous year total}} \times 100$$

**Previous year total:** The annual growth rate is 29.291% for publications and 34.22% for citations, which is highly encouraging figure of growth when compared to the growth in some developed countries (Kaur and Gupta, 2009). The pattern for increase in number of publications and citations is given in Fig. 2 when four year spans are considered.

**Article types:** Nearly ninety percent (89.5%) of publications in pharmacology/pharmacy are in the form of original research articles as shown in Table 2. Number of review papers is next

Table 1: Detail of publications in pharmacology/pharmacy from Pakistan

Parameters	Values
Total publications in pharmacology pharmacy	3,351
Sum of the times cited	23,953
Sum of times cited without self-citations	20,119
Citing articles	17,274
Citing articles without self-citations	15,833
Average citations per item	7.15
h-index	55

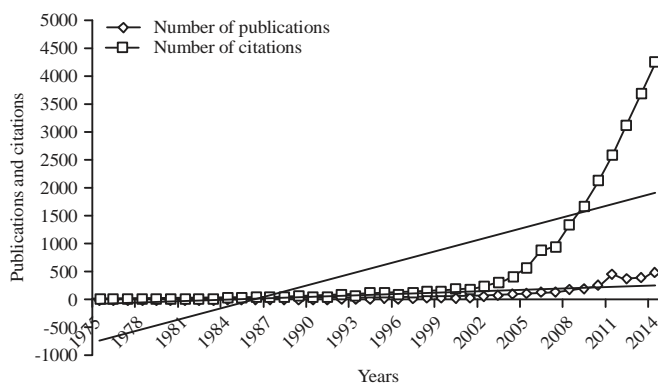


Fig. 1: Year wise publications and citations from Pakistan in the field of Pharmacology/Pharmacy from 1975-2014

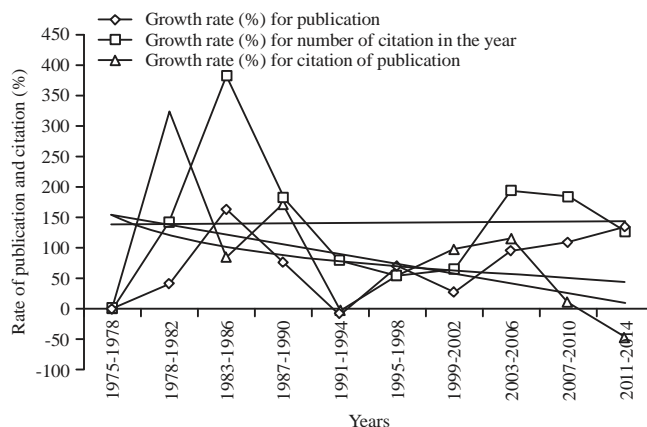


Fig. 2: Span wise percentage average growth rate of publications and citations per article for papers published in Pharmacy/Pharmacology from Pakistan during 1975-2014

Table 2: Publications, their citations, average citation per item and h-index for different article types in the field of pharmacology/pharmacy published from Pakistan

Type	Total papers	Total citations	Average citations/item	h-index	Percentage
Articles	3,013	21,435	7.1	51.0	89.5
Reviews	154	2,240	14.6	25.0	4.6
Abstracts	102	7	0.1	2.0	3.0
Editorials/biography/meeting/correction/books	49	103	2.1	5.0	1.5
Letters	48	238	5.0	10.0	1.4

Table 3: Data showing total number of papers published, total number of citations and average citations per item for papers published from Pakistan as a result of international collaborations in the field of pharmacology/pharmacy

Country	Total papers published	Total citations	Average citations per item
USA	135	1259	9.33
Germany	133	1039	7.81
Saudi Arabia	124	311	2.51
England	107	805	7.52
Malaysia	96	518	5.40
Peoples R China	80	418	5.23
Turkey	65	460	7.08
Canada	59	741	12.56
Italy	56	1483	26.48
Japan	45	616	13.69

to original articles but is only 4.6%. Most of the original research published is a result of either doctoral/post-doctoral studies or supervision of research based degrees. Review articles, abstracts and others are very less as compared to original articles. Thus, scientists need to be encouraged for publishing review articles in addition to original articles and conference/meeting papers.

**International collaboration:** International collaboration is very important for quality publications. Pakistan has collaborated mostly with scientists in Pharmacy/pharmacology of USA as shown in Table 3. Germany is the 2nd and Saudi Arabia the 3rd best amongst the top collaborating countries

with Pakistan in the field of pharmacy/pharmacology. Papers published jointly with Italian scientists are comparatively less in number but have the highest average citations per item (26.48) followed by those with Japan with 13.69 citations per article. Collaborations mostly are as a result of scholarships offered by the Higher Education Commission where students are sent to these countries to complete full or a part of their research in their laboratories. Some senior scientists also work in international projects resulting in collaborative papers of high quality.

**Funding agencies:** Higher Education Commission (HEC) is the major contributor of funds not only for pharmacy/pharmacology research but for other fields as well. These funds are released by HEC either as doctoral scholarships or for the research projects. It is obligatory for scholarship holders to publish their research outcomes, which is the main reason that 76% papers are recognized under HEC as shown in Fig. 3. Seven percent funds for research projects were provided by Pakistan Science Foundation (PSF). University of Karachi also funded projects in the field of pharmacy/pharmacology and thus was acknowledged in 7% papers.

**Top journals:** When number of publications is considered, Pakistan Journal of Pharmaceutical Sciences having impact factor 0.95 is at the top of this ranking in the field of

Table 4: Top 10 most cited papers published from Pakistan in the field of pharmacy/pharmacology from 1975-2014

Year	Journal	Title	Authors	Citations
2005	Natural Product Reports	Aan update on bioactive plant lignans. 22(6):696-716	M. Saleem, H.J. Kim, M.S. Ali, Y.S. Lee	155
2007	Phytotherapy Research	<i>Moringa oleifera</i> : A food plant with multiple medicinal uses. 21(1):17-25	Anwar, Farooq; Latif, Sajid; Ashraf, Muhammad; Gilani, Anwarul Hassan	154
1988	Journal of Natural Products	Oleanderol, a new pentacyclicterterpene from the leaves of nerium-oleander. 51(2):229-233	S. Siddiqui, F. Hafeez, S. Begum, B.S. Siddiqui	148
2005	Journal of Pharmaceutical and Biomedical Analysis	Electrochemical approach of anticancer drugs-DNA interaction.37(2):205-217	S. Rauf, J.J. Gooding, K. Akhtar, M.A. Ghauri	145
2005	Journal of Ethnopharmacology	Trends in Ethnopharmacology. 100 (1-2):43-49	A.H. Gilani, Atta-ur-Rahman	141
2007	Natural Product Reports	Marine natural products of fungal origin. 24(5):1142-1152	Saleem, Muhammad; Ali, Muhammad Shaiq; Hussain, Shafqat; Jabbar, Abdul; Ashraf, Muhammad; Lee, Yong Sup	135
2003	Life Sciences	Effects of flavonoids on vascular smooth muscle of the isolated rat thoracic aorta. 74(5):603-612	M. Ajay, A.U.H. Gilani, M.R. Mustafa	135
2002	Current Medicinal Chemistry	Chemistry and mechanism of urease inhibition. 9(14):1323-1348	Z. Amtul, Atta-ur-Rahman, R.A. Siddiqui, M.I. Choudhary	114
2010	Advanced Drug Delivery Reviews	Development and applications of photo-triggered theranostic agents. 62(11):1094-1124	Rai, Prakash; Mallidi, Srivalleesha; Zheng, Xiang; Rahmanzadeh, Ramtin; Mir, Youssef; Elrington, Stefan; Khurshid, Ahmat; Hasan, Tayyaba	113
2009	Toxicology	Oxidative stress and proinflammatory effects of carbon black and titanium dioxide nanoparticles: Role of particle surface area and internalized amount. 260(1-3):142-149	Hussain, Salik; Boland, Sonja; Baeza-Squiban, Armelle; Hamel, Rodolphe; Thomassen, Leen C.J.; Martens, Johan A.; Billon-Galland, Marie Annick; Fleury-Feith, Jocelyne; Moisan, Frederic; Pairon, Jean-Claude; Marano, Francelyne	109

Table 5: Ranking of Pakistan compared to top 10 publishing countries in pharmacology/pharmacy by Web of Science on the basis of percentage share of total number of papers published from 1975-2014

Countries	Total publications	Percentage share	Rank
USA	408,794	29.99	1
Japan	142,151	10.43	2
England	91,761	6.73	3
Germany	91,692	6.73	4
France	68,871	5.05	5
Italy	66,247	4.86	6
China	58,992	4.33	7
Canada	41,669	3.06	8
India	35,064	2.57	9
Spain	32,342	2.37	10
Pakistan	3,351	0.25	46

pharmacology/pharmacy with 454 papers published in it (Fig. 4). If considered on the basis of citations, average citations per article are the highest for papers published in the Journal of Ethnopharmacology published by Elsevier with an impact factor close to 3. Figure 3 represents top ten journals with most publications and average citations per article from Pakistan.

**Top 10 research articles:** A comparison has been made of highly cited articles published from Pakistan in the field of pharmacy/pharmacology. Table 4 highlights articles that have received enough citations for them to rank in the top 10 for citation counts out of all publications in WoS published from Pakistan in the field of pharmacy/pharmacology.

The research output from Pakistan in the field of pharmacology/pharmacy obviously lags behind when compared with that of the developed countries (Table 5).

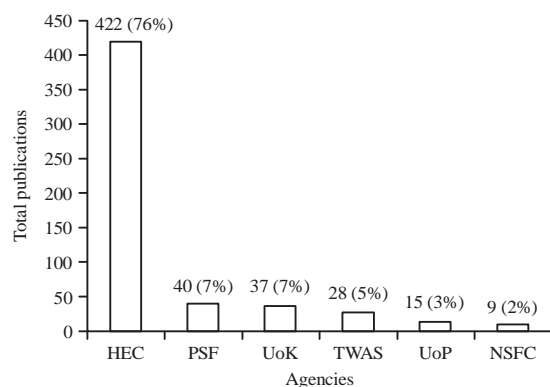


Fig. 3: Articles produced under funding of different agencies, HEC: Higher Education Commission, PSF: Pakistan Science Foundation, UoK: University of Karachi, TWAS: The Academy of Sciences for the Developing World, UoP: University of Peshawar, NSFC: National Natural Science Foundation of China

However, when compared with some Asian countries which are ranked in top 100 publishing countries in the field of pharmacology/pharmacy by Web of Science, Pakistan holds 13th rank, which is encouraging though further improvement can be achieved (Table 6).

Distribution of the research output for top 10 countries and Pakistan in seven blocks of 5 years each (Fig. 5) indicates that only 87,693 papers were produced in the first block (1975-1979) as compared to 296,679 papers produced in the last block (2010-2014). The main

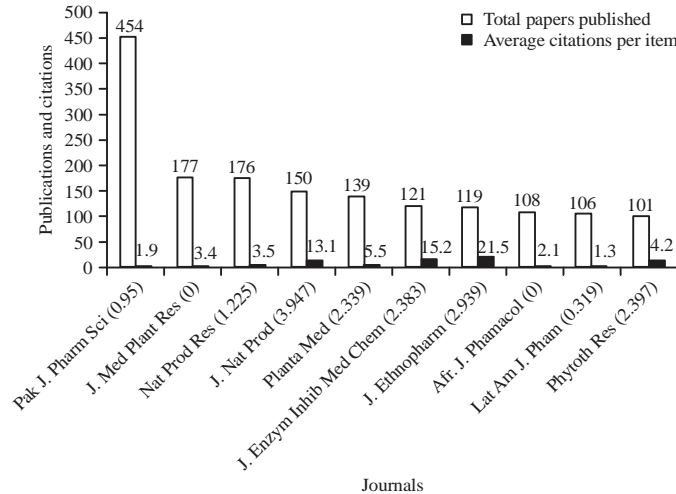


Fig. 4: List of ten most frequently used journals with JCR 2013 impact factors by Pharmacologists/Pharmacists of Pakistan for publishing their study output showing number of total papers published and average citations per item for these papers

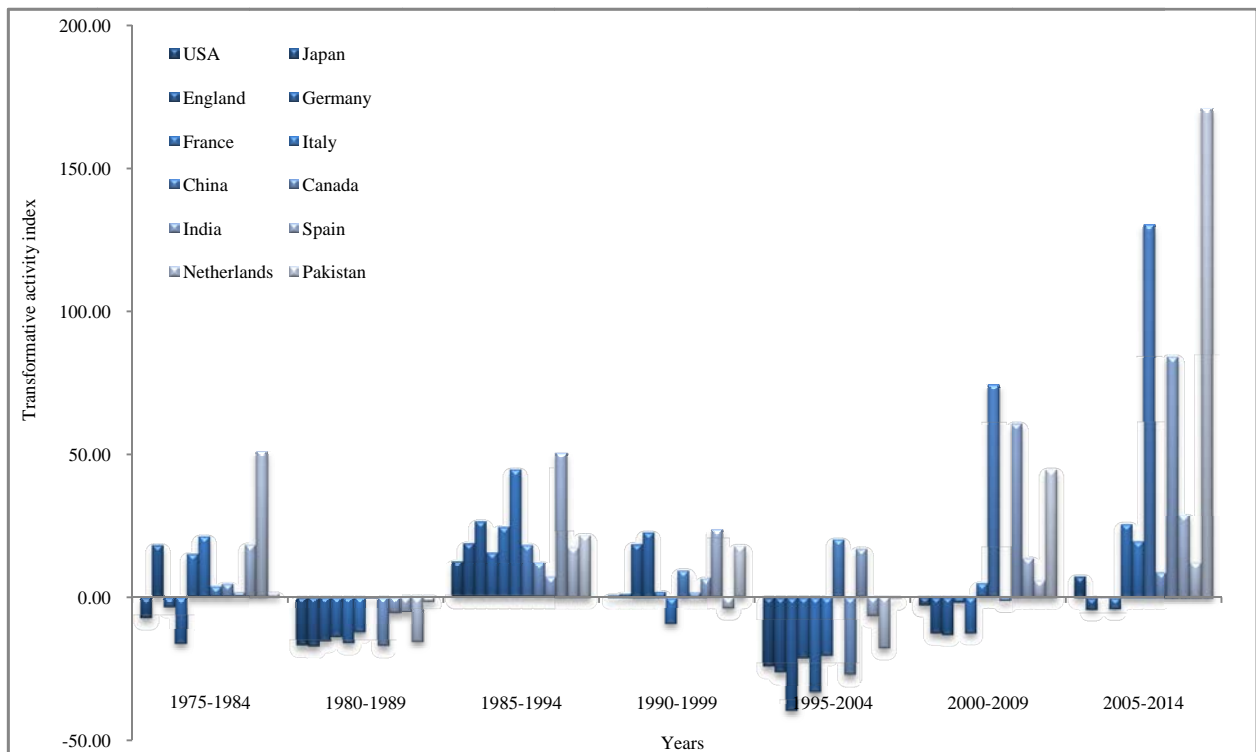


Fig. 5: Change in the values of the Transformative Activity Index (TAI) for different countries

contributors among these countries were the USA, Japan and England. The Transformative Activity Index (TAI) was developed to compare the relative change in the output during these seven blocks (Guan and Ma, 2004). Mathematically:

$$TAI = \frac{C_i/C_o}{W_i/W_o} \times 100$$

where,  $C_i$  is the number of publications of the specific country in the  $i$ th block,  $C_o$  is the total number of publications of the specific country during the period of study,  $W_i$  is the number of publications of all countries in the  $i$ th block and  $W_o$  is the number of publications of all the countries during the period of study.

The values of TAI for different countries (Fig. 5) suggest that the publication activity was the highest in 1985-1994 for

Table 6: Comparative ranking of Pakistan with selected asian countries ranked under top 100 countries by Web of Science from 1975 to 2014 in pharmacology/pharmacy

World rank	Rank in Asian countries	Country	Publications	Citations	Cit/Pub
2	1	Japan	142151	1869910	13.15
7	2	China	58992	611628	10.37
9	3	India	35064	381033	10.87
13	4	South Korea	24988	302881	12.12
21	5	Taiwan	13316	191798	14.40
23	6	Turkey	12302	116740	9.50
27	7	Israel	9137	171642	18.83
28	8	Iran	8091	57909	7.20
33	9	Russia	6638	47614	7.18
39	10	Thailand	4878	62362	12.80
43	11	Saudi Arabia	3819	30065	7.90
45	12	Singapore	3548	64926	18.30
46	13	Pakistan	3,351	23956	7.10
48	14	Malaysia	3191	22368	7.00
63	15	Hong Kong	1158	19818	17.11
66	16	Uzbekistan	953	2921	3.07
68	17	Indonesia	827	889	1.10
69	18	Vietnam	781	8628	11.00
73	19	Bangladesh	672	613	0.90
75	20	United Arab Emirates	633	6513	10.30
77	21	Kuwait	590	6532	11.10
81	22	Philippines	480	4957	10.33
82	23	Lebanon	468	4025	8.60
87	24	Sri Lanka	333	3650	11.00
92	25	Iraq	284	1998	7.00
97	26	Kazakhstan	227	750	3.30
100	27	Nepal	208	1798	8.60

all countries under study after which it has decreased considerably in 1995-2004 but gradually improved in last decade.

### CONCLUSION

The present study is the first report to reveal the contribution of Pakistani scientists in the area of, pharmacology/pharmacy research. It is clear from the present study, that the volume and quality of research in pharmacology and pharmacy presents a positive trend in Pakistan from 2001 onwards, as measured by the number of articles published in ISI-indexed journals and citations. Our analysis showed that the research output from Pakistan in the field of pharmacology/pharmacy lags behind when compared that in the developed countries but when compared with top 100 publishing Asian countries in the field of pharmacology/pharmacy, pakistan occupies 13th position.

### REFERENCES

Bilir, S., E. Gogus, O. Onal, N.D. Ozturkmen and T. Yontan, 2013. Research performance of Turkish astronomers in the period of 1980-2010. *Scientometrics*, 97: 477-489.

Du, J. and X.L. Tang, 2014. Natural products against cancer: A comprehensive bibliometric study of the research projects, publications, patents and drugs. *J. Cancer Res. Therapeut.*, 10: 27-37.

EFPIA., 2013. The pharmaceutical industry in figures: Key data 2013. The European Federation of Pharmaceutical Industries and Associations (EFPIA), Brussels, Belgium, pp: 1-27. [http://www.efpia.eu/uploads/Figures\\_Key\\_Data\\_2013.pdf](http://www.efpia.eu/uploads/Figures_Key_Data_2013.pdf)

Friedberg, A., 2000. Will Europe's past be Asia's future? *Survival: Global Polit. Strat.*, 42: 147-159.

Fu, H.Z., M.H. Wang and Y.S. Ho, 2013. Mapping of drinking water research: A bibliometric analysis of research output during 1992-2011. *Sci. Total Environ.*, 443: 757-765.

Fu, H.Z., Y.S. Ho, Y.M. Sui and Z.S. Li, 2010. A bibliometric analysis of solid waste research during the period 1993-2008. *Waste Manage.*, 30: 2410-2417.

Gopalakrishnan, S. and L.A. Kumar, 2013. Global literature output on textile research: A bibliometric study. *J. Adv. Library Inform. Sci.*, 2: 94-99.

Guan, J. and N. Ma, 2004. A comparative study of research performance in computer science. *Scientometrics*, 61: 339-359.

Han, J.S. and Y.S. Ho, 2011. Global trends and performances of acupuncture research. *Neurosci. Biobehav. Rev.*, 35: 680-687.

Kaur, H. and B.M. Gupta, 2009. Indian contribution in pharmacology, toxicology and pharmaceuticals during 1998-2007: A scientometric analysis. *Collnet J. Scientometrics Inform. Manage.*, 3: 1-9.



- Li, J.F., M.H. Wang and Y.S. Ho, 2011. Trends in research on global climate change: A science citation index expanded-based analysis. *Global Planetary Change*, 77: 13-20.
- Liu, X., F.B. Zhan, S. Hong, B. Niu and Y. Liu, 2012. A bibliometric study of earthquake research: 1900-2010. *Scientometrics*, 92: 747-765.
- Luukkonen, T., 1990. Bibliometrics and evaluation of research performance. *Ann. Med.*, 22: 145-150.
- Nasir, S. and J. Ahmed, 2013. Incentives matter: The role of research productivity award in increasing scientific output of Pakistani scientists. *Sci. Technol. Dev.*, 32: 251-256.
- Sainte-Marie, B., 2010. The first 30 years of the journal of crustacean biology-a bibliometric study. *J. Crustacean Biol.*, 30: 541-549.
- Shi, S., C. Yue, L. Wang, X. Sun and Q. Wang, 2012. A bibliometric analysis of anaerobic digestion for butanol production research trends. *Procedia Environ. Sci.*, 16: 152-158.
- Tanaka, H. and Y.S. Ho, 2011. Global trends and performances of desalination research. *Desalinat. Water Treat.*, 25: 1-12.
- Taubes, G., 1993. Measure for measure in science. *Science*, 260: 884-886.