

Full Length Research Paper

# A scientometric portrait of Swaran Jeet Singh (SJS) flora

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This paper presents the scientometric portrait of Dr. Swaran Jeet Singh Flora, a well-known scientist of Defence Research Development Establishment (DRDE), Ministry of Defence, Gwalior, India. Dr. SJS Flora has published a total of 278 articles in national and international journals on various domains like arsenic, lead, drug development for metal toxicity, oxidative stress and role of antioxidants, etc. On an average, he produces 10 research publications per year. As a record, he had 21 publications during the year 2005. An exponential growth in number of publications was observed during 1981 to 2008. The highest growth rate (45%) was recorded during 2001 to 2004 with 58 publications followed by 66 (17.79%) publications during 2005 to 2008. S.J.S. Flora has collaborated with 103 researchers throughout the world till date.

**Key words:** Swaran Jeet Singh Flora, Defence Research Development Establishment, Industrial Toxicology Research Centre, scientometry.

## INTRODUCTION

Scientometric portrait studies deal with the biographical study of the individual career of scientists and research scholars and correlating bibliographical analysis of publications or academic and scientific achievements (Sangam et al., 2007). Scientific publications provide the best available basis for measuring the research output. In this paper, an attempt has been made to analyze the scientific work done by Dr. Swaran Jeet Singh (SJS) Flora, a well-known scientist in Defence Research Development Establishment (DRDE), Ministry of Defence and also to know his role in the advancement of science in India and abroad. Dr. S. J. S. Flora (Flora, 2009) was born in Lucknow, Uttar Pradesh in 07 Mach 1956. He obtained Bachelor of Science degree from Lucknow University and Master of Science (chemistry) degree from University of Kanpur in 1978. He then stepped into his

research career and obtained his PhD degree (chemistry/toxicology) from Industrial Toxicology Research Centre, Lucknow during January 1985. He later underwent extensive Post Doctoral training at Utah State University, USA on Toxicology Program during 1985 to 1986.

He served as the Junior and Senior Research Fellow of ICMR at ITRC, Lucknow 1980 to 1985, senior research officer (ICMR-SRO) at Industrial Toxicology Research Centre (ITRC) Lucknow, 1986 to 1989. He was appointed as a scientist 'C' in Defence R and D Establishment, Ministry of Defence, Gwalior, 1989 to 1994 and was promoted to scientist 'D' at DRDE, Gwalior, 1994 to 1999; Deputy Director (scientist E) at Defence R and D establishment (DRDE), Gwalior, 1999 to 2004; Joint Director and Head Division of Pharmacology and Toxicology at Defence Research and Development Establishment (DRDO, Ministry of Defence, Government of India), Gwalior from 2004 till date. He has completed successfully 16 research projects at DRDO. He has

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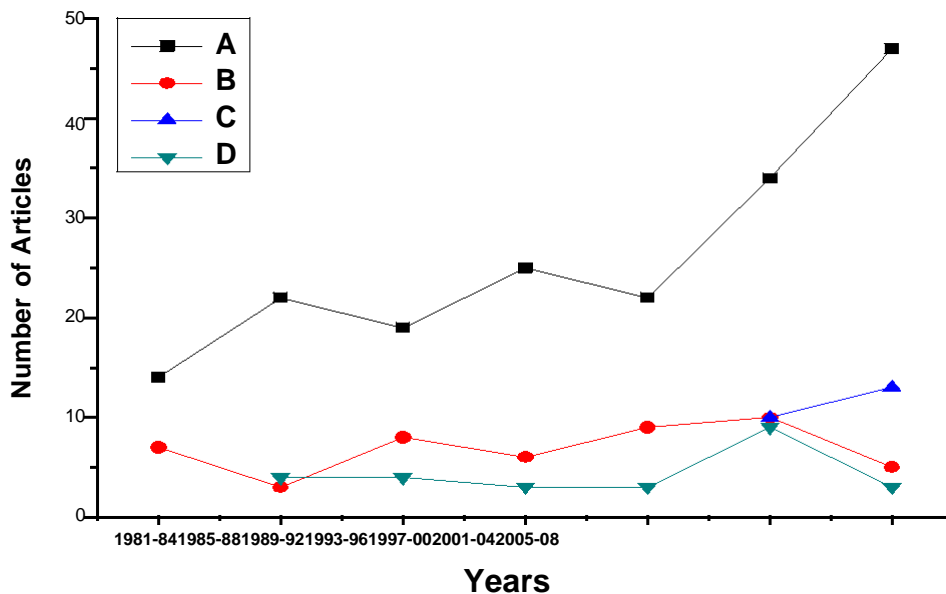


Figure 1. Domain-wise publications productivity of S. J. S. Flora.

guided successfully 19 students for their research projects. In addition he has participated in over 111 National and International Conferences. Dr S. J. S Flora has been associated with more than 11 international journals of the various countries as a member of editorial board. Dr S. J. S. Flora actively associated with DRDO and DRDE committees. He is also a life member of major Chemistry, Pharmacology and Life Sciences Societies and chairman of various scientific sessions (international and national). It is the matter of pride to all the scientists of DRDO in India that Dr. S. J. S. Flora has his own image as a Researcher, Scientist, a Professional and an expert in the field.

He is associated with the other institutions like AIIMS, ITRC, etc. Currently, he is working as scientist 'F' at the capacity of Joint Director and Head of the Division at Defence Research and development Establishment, DRDO, Ministry of Defence at Gwalior, India.

## OBJECTIVES OF THE STUDY

The present study was undertaken to analyze the publications of a successful professional scientist in Life Sciences and Chemistry and create 'role model' for the younger generation. The specific objectives of the present study are to highlight Dr. S. J. S Flora's:

- 1) Year-wise contributions,
- 2) Scientific domain – the authorship pattern,
- 3) Growth rate of publication, production, collaboration, rate references and their collaboration,
- 4) Use of channels communications and,
- 5) Application of Brodford-Zips's law.

## METHODOLOGY

Keeping in view the objective of the study, the complete bibliography of research publications by S. J. S. Flora (1981 to 2008) was collected and standard bibliometric fields were analyzed by normal count procedure for domains, authorship and channels of communication.

## RESULTS AND DISCUSSION

### Domain-wise contributions

S. J. S. Flora had research communication in the following domains.

A = arsenic lead.

B = drug development in metal toxicity.

C = oxidative stress, role of antioxidants.

D = miscellaneous.

During 1981 to 2008, S. J. S. Flora had contributed 47 papers in the domain of arsenic lead (2005 to 2008), followed by 34 papers in 2001 to 2004, 25 papers in 1993 to 1996, 22 papers in 1985 to 1988 respectively. It is observed that only few numbers of papers, that is, less than 10 papers have been contributed in other domains. This is illustrated in Figure 1.

### Scientific domain-wise authorship pattern

The tables depicts authorship pattern from different domains. Table 1 provides the information about authorship patterns and number of publications in each domain. Out of the second authorship papers, arsenic

**Table 1.** Publication productivity and authorship patterns of S. J. S. Flora in various scientific domains.

Status of authorship	Domains				Total no. of papers published	Percentage (%)	Total no. of authorship	Percentage (%)
	A	B	C	D				
1-author	32	13	3		48	17.27	48	6.52
2-author	70	12	13	6	101	36.33	202	27.45
3-author	42	10	2	10	64	23.02	192	26.09
4-author	29	8	2	4	43	15.47	172	23.37
5-author	7	5	2	2	16	5.76	80	10.87
6-author	2		1	1	4	1.44	24	3.26
7-author	1				1	0.36	7	0.95
11-author				1	1	0.36	11	1.49
Total	183	47	23	24	278	100	736	100
Percentage (%)	65.83	16.91	8.27	8.63	100			
CC	0.508	0.461	0.512	0.667				
Authorship per paper	2.56	2.64	2.57	3.54				

**Table 2.** Growth rate of publications.

Four year block	No. of publications	Growth rate 1981 - 2008 (%)
1981 - 1984	22	-
1985 - 1988	30	36.36
1989 - 1992	30	0
1993 - 1996	34	13.33
1997 - 2000	40	17.65
2001 - 2004	58	45
2005 - 2008	66	17.79
Total	280	

lead papers were 70, followed by 13 in oxidative stress, and role of antioxidants, 12 papers in drug development and 6 papers in the miscellaneous domain. Of three-authored papers, arsenic papers were 42, followed by 10 in drug development in metal toxicity, 10 papers in miscellaneous and 2 papers in oxidative stress, role of antioxidants. Of four-authored papers, 29 papers were published in the arsenic followed by 8 in drug development in metal toxicity, 4 papers in miscellaneous and 2 papers oxidative stress, role of antioxidants. Of five-authored papers, arsenic lead papers were 7, followed by five papers in drug development in metal toxicity, 2 in oxidative stress, role of antioxidants, 2 in miscellaneous. Of six-authored papers, 2 papers were published in arsenic lead, followed by 1 paper in oxidative stress and 1 paper in miscellaneous.

There is only one of seven-authored paper in the domain arsenic lead and one eleven- authored paper published in the domain miscellaneous.

### Growth rate of publications

An exponential growth in number of publications was

observed during 1981 to 2008. The highest growth rate (45.00%) was found during the period of 2001 to 2004 with 58 publications followed by 66 (17.79%) publications during 2005 to 2008. Table 2 illustrates the growth rate of publications of S. J. S. Flora.

### Productivity

Communication and collaboration between researchers are of great importance in the development of subject areas and in the dissemination of research results. Collaboration is an intense form of interaction that allows effective communication as well as the sharing of competence and other resources (Subramaniam, 1983). S. J. S. Flora had published 47 single-authored and 233 multi-authored papers during 1981 to 2008. The multi-authored papers include: two authored (102), three authored (66), four authored (41), five authored (16), and six authored (7), seven authored (1). Table 3 shows that the first paper of the author was published in 1981 when he was at the age of 25. S. J. S. Flora had 48 publications in various domains as arsenic lead (32), drug

**Table 3.** Publication productivity of S.J.S. Flora in chronological order.

APL	Year	Authorship pattern							MT	TP	AA
		1	2	3	4	5	6	7			
1	1981				2				2	2	25
2	1982				3				3	3	26
3	1983		4	5					9	9	27
4	1984		3	3	2				8	8	28
5	1985		1	4					5	5	29
6	1986		8	1	1				10	10	30
7	1987		5	3	2				10	10	31
8	1988		3	2					5	5	32
9	1989	1	4	2	2				8	9	33
10	1990	1	3	3	1				7	8	34
11	1991	3	1	3	2				6	9	35
12	1992	1	1	1		1			3	4	36
13	1993	2	3	1	1				5	7	37
14	1994	1	2	5	1	2			10	11	38
15	1995	1	3	4		2			9	10	39
16	1996	3	2	1					3	6	40
17	1997		2	3	3	1	4		13	13	41
18	1998	1	7	2	2	1			12	13	42
19	1999	3	2	2					4	7	43
20	2000	2	1	3		1			5	7	44
21	2001		1		3	1			5	5	45
22	2002	6	3	4	2		2		11	17	46
23	2003	4	6	3	3	1			13	17	47
24	2004	2	9	3	5				17	19	48
25	2005	6	10	3	2				15	21	49
26	2006	7	8	2	1	1	1		13	20	50
27	2007	3	9	2	2	3		1	17	20	51
28	2008		1	1	1	2			5	5	52
	Total	47	102	66	41	16	7	1	233	280	

APL - age of productive life, MT – total number of multi-authored publications, TP – total publications, AA – biological age of the author.

development in metal toxicity (13), oxidative stress, role of antioxidants (3) and year wise productivity of S. J. S. Flora is shown in Figure 2.

### Collaboration rate

During 1981 to 2008, a total of 280 publications were published by S. J. S. Flora. The average number of publications produced per year was 10 articles. The highest number of publications, 21 articles was published in the year 2005. Table 4 gives year-wise growth and collaboration rate. It can be clearly visualized from Table 4 that the growth of the literature was very low during 1981 to 1984, 1988 to 1993, 1996 and 1998 to 2000; and it peaked during 1986 to 1987, 1994 to 1995, 1997 to 1998

and 2002 to 2007.

### Researchers and their collaboration

In recent years, most of the countries realized the importance of collaborative research especially in the field of science and technology, and have programmes that encourage the scientists to work collectively and contribute for the advancement of countries of the world (Uzun, 1998). An attempt has been made to know collaborative work of S. J. S. Flora. Table 5 depicts that S. J. S. Flora has collaborated with 103 researchers till 2008. It had been observed that S. K. Tandon had collaborated with S. J. S. Flora in the production of maximum number of papers that is 70 published during

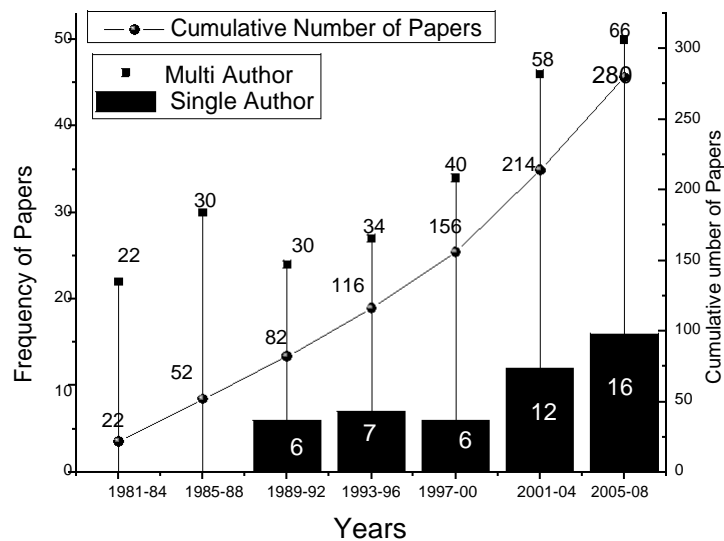


Figure 2. Publication productivity of S. J. S. Flora.

Table 4. Year-wise publication productivity and collaboration rate.

Year	Single authored papers	Multi authored papers	Total	C. R.
1981		2	2	1
1982		3	3	1
1983		9	9	1
1984		8	8	1
1985		5	5	1
1986		10	10	1
1987		10	10	1
1988		5	5	1
1989	1	8	9	0.89
1990	1	7	8	0.87
1991	3	6	9	0.66
1992	1	3	4	0.75
1993	2	5	7	0.71
1994	1	10	11	0.90
1995	1	9	10	0.9
1996	3	3	6	0.5
1997		13	13	1
1998	1	12	13	0.92
1999	3	4	7	0.57
2000	2	5	7	0.71
2001		5	5	1
2002	6	11	17	0.64
2003	4	13	17	0.76
2004	2	17	19	0.89
2005	6	15	21	0.71
2006	7	13	20	0.65
2007	3	17	20	0.85
2008		5	5	1
<b>Total</b>	<b>47</b>	<b>233</b>	<b>280</b>	<b>0.83</b>

C.R. = collaboration rate.

**Table 5.** Authorship credits of researchers collaborating with S. J. S. Flora in chronological order.

S. no.	Author name	Domain				Period of association	TY	No. of authorship
		A	B	C	D			
1	S. J. S Flora	178	38	31	33	1981-2008	28	280
2	V. K. Jain	1	1			1982-1984	3	2
3	J. R. Behari	4	1		2	1981-1984	4	7
4	S. K. Tandon	51	8		11	1981-2003	23	70
5	M. Ashquin				2	1982-1984	3	2
6	S. Singh	12			2	1982-1994	13	14
7	Shashi K.		4		1	1984-1990	7	5
8	Surendra Singh	4				1981-1985	5	4
9	R. P. Sharma	4			2	1986-1987	2	6
10	D. B. Drown				2	1986-1987	2	2
11	S. G. Oberg				2	1986-1987	2	2
12	P. C. Tewari	1			1	1987-1988	2	2
13	R. A. Coulombe	2				1987-1989	3	2
14	Mamta Dhawan	4			2	1989-1999	11	6
15	S. Dasgupta	8	2		3	1989-1994	6	13
16	Deo kumar	3	1			1990-1993	4	4
17	S. R. S. Sachan	2	1			1990-1994	5	3
18	Seema Mathur	1	2		2	1993-1995	3	5
19	R. Mathur	1	3	1	5	1991-2004	14	10
20	Pradeep Kumar	3	1			1993-1998	6	4
21	K. Jeevaratnam	1				1993	2	1
22	S. C. Pant	7			4	1994-2008	15	11
23	A. S. Sachan	3				1994-1996	3	3
24	G. P. Rai	3				1994-1998	5	3
25	R. Bhattacharya	3			1	1992-1995	4	4
26	G. M. Kannan	25	5	9	4	1994-2007	14	43
27	S. P. Saxena				2	1992-1994	3	2
28	Pravin Kumar				2	1992-1994	3	2
29	S. N. Dube	10	3		3	1994-2005	12	16
30	Uma Sharma		1			1995	1	1
31	N. Maheshwari		1			1995	1	1
32	S. Sapre		1			1995	1	1
33	A. K. Sharma		1			1995	1	1
34	Usha Arora	1				1995	1	1
35	P. R. Malhotra	5				1994-1997	4	5
36	Vijaya Raghavan	2				1995-1997	12	2
37	G. J. S. Flora	5				1995-2006	1	5
38	P. K. Seth	1				1997	8	1
39	B. P. Pant	8		2	1	1997-2004	5	11
40	Neelima Tripathi	8	3				7	11
41	D. K. Jaiswal	4		1		1997	1	5
42	R. P. Bandwar				1	1997-2006	10	1
43	C. P. Rao			1	1	1997-2004	8	2
44	Udita Gubrely		5		2	1998	1	7
45	Priya Srivastava		1			1998	7	1
46	Anjana Vij	1		1		1998-2004	7	2
47	N. K. Satija	1		1		1994-1999	6	2
48	P. Kumar	2				2000-2003	4	2
49	Kiran Satsangi		1	2	1	2000-2007	8	4
50	P. C. Jatav		1	1		2000-2002	3	2

Table 5. Contd.

51	K. K. Dua		1		1	2000-2002	5	2
52	Manisha Pande	5		1		2001-2005	8	6
53	Ashish Mehta	5	2	6	5	2001-2008	1	18
54	Manju Gupta	1				2001	1	1
55	Rupa Dubey	1				2002	1	1
56	R. S. Chauhan	1				2002	1	1
57	Smarati Bhaduria	8		2		2003-2007	5	10
58	P. V. L. Rao	1				2004	1	1
59	A. S. B. Bhaskar	1				2004	1	1
60	M. Singh		1			2004	1	1
61	Geetu Saxena	8		6	1	2003-2007	5	15
62	Manoj Modi	8				2002-2007	6	8
63	Richa	2		1		2004	1	3
64	Uma Pathak	1		1		2005-2007	3	2
65	Kiran Kalia	2		1		2005-2007	3	3
66	Richa Gupta	4		1		2005-2007	3	5
67	R. K. Dhaked	2				2004-2005	2	2
68	Mamata Sharma	1				2005	1	1
69	Uma Joshi	1				2005	1	1
70	R. K. Kaul		1	1		2006	1	2
71	A. Ali			1		2006	1	1
72	E. Kolehmainen			1		2006	1	1
73	B. Mahieu			1		2006	1	1
74	D. N. Saksena			1		2006	1	1
75	R. J. Tripude			1		2006	1	1
76	D. K. Dubey	1				2007	1	1
77	G. Narula			1		2007	1	1
78	Megha Mittal	4	1	2		2004-2008	5	7
79	Pratibha Gautam			3		2007	1	3
80	Pushpinder Kaur			1		2007	1	1
81	K. D. Gill			1		2007	1	1
82	Deepshikha Mishra	3	1	1	1	2006-2008	2	1
83	H. T. Satish	1				2007	1	6
84	Manju Lata Gupta				1	2007	1	1
85	S. Tyagi				1	2007	1	1
86	P. Agarwala				1	2007	1	1
87	P. Choudhry				1	2007	1	1
88	S. C. Puri				1	2007	1	1
89	M. Devi				1	2007	1	1
90	A. Sharma				1	2007	1	1
91	A. Haksar				1	2007	1	1
92	G. N. Qazi				1	2007	1	1
93	R. P. Tripathi				1	2007	1	1
94	Kapil Bhat	1	1			2007-2008	1	1
95	Sameer S. Bhagyanant		1			2007-2008	1	2
96	R. K. Purohit				1	1996	1	1
97	Nutan Singh	1				2007	1	1
98	G. Flora	1	1			2007	1	1
99	Manisha Mishra	1				2007	1	2
100	R. V. Swamy				1	1998	1	1
101	K. Sekhar	2				2004	1	2

**Table 5. Contd.**

102	Shashi Dube		1			2004	1	1
103	B. Pandey	1				2005	1	1
	Total	437	95	85	112			730

A = arsenic lead, B = DRUG development in metal toxicity, C = oxidative stress, role of antioxidants, D = miscellaneous and TY = total years of collaboration.

**Table 6.** Distribution of publications in various types of channels of communications.

Document type	Number of articles	Percentage (%)
Articles	134	47.85
Seminar	119	42.50
Reviews	15	5.35
Chapter in books	12	4.28
Total	280	99.98

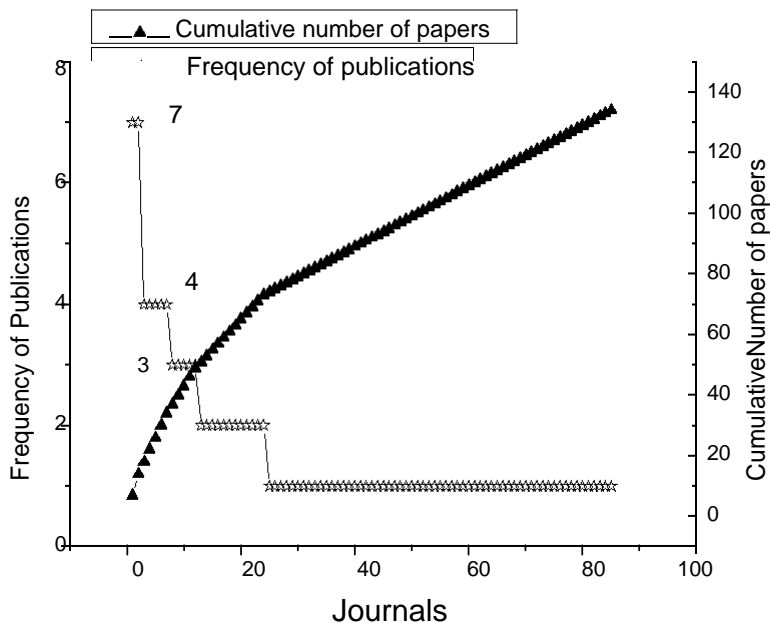
**Table 7.** Preference of channels of communication.

S. no.	Rank	Channels	No of articles	Impact factor
1	1	Biological Trace Element Research	7	0.95
2	2	Journal of Applied Toxicology	7	2.15
3	3	Toxicology Letters	4	3.35
4	3	Chemical Biological Interaction	4	3.15
5	3	Human and Experimental Toxicology	4	1.335
6	3	Journal of Trace Elements in Med. and Biology	4	2.481
7	3	Journal of Tissue Research	4	0.786
8	4	Pharmacology and Toxicology	3	2.81
9	5	Ecotoxicology and Environmental Safety	3	2.914
10	5	Biomedical Environmental sciences	3	0.557
11	5	Biometals	3	3.17
12	5	Toxicology	3	3.481
13	6	Life sciences	2	2.257
14	6	Bulletin of Environmental Contamination and Toxicology	2	0.563
15	6	Indian Journal of Physical Pharmacology	2	
16	6	Clinical Chemistry Enzyme	2	1.741
17	6	Alcohol	2	2.14
18	6	Biomedical and Environmental Sciences	2	0.557
19	6	Journal of Trace Elements in Med. and Biology	2	2.56
20	6	Comparative Biochemistry and Physiology Part: Pharmacology	2	2.45
21	6	Cellular and Molecular Biology	2	1.154
22	6	Environmental Toxicology and Pharmacology	2	1.281
23	6	Toxicology and Industrial Health	2	0.731
24	6	Industrial Health	2	
25		61 Journals published one (1) article each	61	

1981 to 2003; G. M. Kannan follows next with 43 papers during 1994 to 2007, S. N. Dube with 16 papers during 1994 to 2005. Researchers collaborated with S. J. S Flora only in one paper number 44; two papers each

number 21; three papers each number 6; four papers each number 5 only; total authorship credit for 103 authors count 730, each collaborating author being given 1 authorship credit for each paper S. J. S Flora to his





**Figure 3.** Bradford-Zipf bibliograph for S. J. S. Flora.

**Table 8.** Distribution of papers and journals according to zones.

Zones	1st	2nd	3rd
Papers	43	44	47
Journals	10	28	47

credit has (280/730) 38.35% of total authorship credit.

### Channels of communication

S. J. S. Flora communicated their publications through variety of communication channels. Table 6 depicts that 47.85% of the literature that is 134 articles was published in the form of journal articles followed by 119 articles published in seminars conference proceedings (42.50%), reviews (5.35%) and 12 published chapters in books (4.28%) (Keshava, 2008). Journal wise scattering of publications of S. J. S Flora is provided in Table 7. Top ranking journals with a number of publications are: Biological Trace Element Research articles (7), Journal of Applied Toxicology (7), followed by Toxicology Letters (4), Chemical Biological Interaction (4), Journal of Tissue Research (4), Human Exp. Toxicol (4), Pharmacology and Toxicology (3), Ecotoxicol, Environ safety (3), Biometals (3) and Toxicology (3) each.

### Bradford-Zipf's law

Bradford's law is one of several statistical expressions

that try to describe the workings of science by mathematical means (Garfield, 1979). It describes how the literature on a particular subject is scattered or distributed in the journals. If journals are ranked by the number of articles they contain on a given topic, they can be divided into a central nucleus of the most important journals and a series of zones each containing the same number of articles as the nucleus (but each containing many more journals). In addition, ZIPF's Law (1972) describes the frequency distribution of words in a given text with familiar words being used many times and many words being used only once. Bradford's and Zipf's laws have been shown to be mathematically identical and so the distribution is often referred to as the Bradford – Zipf distribution (Brookes, 1968) (Figure 3). S. J. S. Flora has contributed 134 papers in reputed journals during the period for this study. To test whether or not his contributions follow Bradford distribution, each zone has around 44 papers. The nine journals account for 43 papers. As 43 is closer to 44, hence 43 falls in the first zone. The remaining papers fall in the second and third zones. Zone-wise papers and the journals can be divided as follows (Table 8). It is found from the journals in the first zones that the Bradford multiplier is  $28/10 = 2.8$ .

According to this multiplier, the number of periodicals in

the third zone should be  $10 \times 2.8 \times 2.8 = 78.4$  which is far from the actual number 47. Hence the data does not strictly follow the Bradford-Zipf's law.

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