COMMUNICATION AND COLLABORATIVE RESEARCH PATTERN OF NOBEL LAUREATE YOSHINO AKIRA : A SCIENTOMETRIC PORTRAIT

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Abstract

The present investigation presents scientometric portrait of Nobel Laureate Yoshino Akira. Scientometric portrait studies deal with the biographical study of productive career of individual scientist. Yoshino Akira has contributed outstanding to the field of Chemistry in common and in specified to electrochemistry, in which he was awarded Nobel Prize for developing Lithium-ion Batteries. In his entire productive career he has collaborated with 1124 fellow scientists and has published 480 articles during 1989-2019. Out of 480 publications 72.20% are journal articles, 14.16% are meeting abstract, 3.75% are letters, 3.54%are conference papers, 1.25% are notes, 0.62% are reviews and 0.41% are corrections. His main domains can be categorised as 7 domains namely; Medicinal Chemistry 46.66% publications toped in the list of domains, Biochemistry with 17.91% publications, in multidisciplinary 15.41% publications, Organic Chemistry 12.29%, Physical Chemistry 4.16% and Pharmacology 0.20%. It has been concluded that he is a source of inspiration for the upcoming generations in the field of Chemistry.

Keywords : ***Scientometrics; Yoshino Akira; Co- Authorship Analysis; Chemistry; VOS Viewer.***

Introduction

Yoshino Akira a 71 year old Japanese chemist who awarded Nobel Prize for outstanding contributions in developing Lithium-ion Batteries in collaboration with JB Goodenough, an American Chemist and British born American Chemist M Stanley Whittingham. He has completed his B S Degree in 1970, M S Degree in engineering from Kyoto University and obtained his Doctorate degree form Osaka University. He was performed many challenging tasks like President of the Lithium-ion Battery Technology and Evaluation Center in 2010, Professor at Meijo University, and as visiting professor at Kyushu University and then honorary fellow at Asahi Kasei. He has 6 patents to his credit in the field of lithium-ion barriers (Gregersen, 2020). Yoshino Akira is the first Asian to receive Nobel Prize in Chemistry. Yoshino discovered that carbonaceous material with a specific crystalline structure was reasonable as anode material, and this is the anode material that was utilized in the original of commercial LIBs. Yoshino built up the aluminium foil current authority which shaped a passivation layer to empower high cell voltage requiring little to no effort and built up the utilitarian separator membrane and the utilization of a positive temperature coefficient (PTC) device for additional safety.

Literature Study

In this section reviewed previous studies on Nobel Laureates in Science disciplines, they are:

Gupta (1983) has conducted citation analysis study on S. Chandrashekar Nobel Laureate in physics, opines that high correlation in quantity, quality of works, citedness and receiving honours and awards, and opines that he has set up very high standard for his followers to surpass it. **Kademani et al., (1994)** have thrown light on scientific career of Noble Laureate in Physics C V Raman, studied the activeness in his research productions which, in which they have proved that C V Raman as role model. **Kalyane**

& Sen (1996) have evaluated 422 research outcomes of Pierre-Gilles de Gennes Nobel Prize winner in Physicswith scientometric concepts of productive career, in this study they have been applied bradford's law of scattering to know ratio of article scattered in journals. **Kalyane & Kademani (1997)** come with a scientometric study on Nobel Laureate in Physiology Barabara McClintock, in which they have focused on productive life of McClintock, more than 90% of papers follows solo authorship pattern. **Kademani et al. (2001)** have tested with elements of scientometrics of 246 publications by Nobel Laureate in Chemistry Ahmed Hassan Zewail. Authors opine that awards and honours capable to grab attention of fellow researchers in the field. **Kademani et al. (2002)** demonstrated a detailed scientometric analysis of 192 publications of Harold Kroto Winner of Nobel Prize in Chemistry, in which they have provided in detail about the publication growth, dominant collaborator, core journals to publish his papers, dominant keywords used in the paper. **Koganuramath et al., (2004)**studied the 115 research output of Nobel Laureate in Physics Ketterle are tested scientometrically to prove that he is role model for fellow researchers in Physics, suggested that 'Scientometric portrait' is appropriated phrase for studies on scientists and 'Informetric portrait' for the researchers in other disciplines. **Kademani et al., (2006)** have presented scientometric study on Noble Laureate in Chemistry Dorothy Crowfoot Hodgkin, in the publications examined with biobibliometric concepts. **Sangam et al., (2006)** have explored the research pattern of G. N. Ramachandran, in which they elaborated on productive career output scattered in various field and has proven that he is the role model for younger scientist in the field of chemistry. **Sangam et al., (2006)** have brought scientometric portrait study on Prof. Peter John Wyllie which is an exploratory study includes the citations, authorship details, source titles used for communication, authorship credits etc.

Objectives of the Study

The main objective of study is to measure the research pattern of Yoshino Akira. The specific objectives of the study are;

1. Year-wise authorship patterns;
2. To find the Channels of Communications;
3. To identify the Domains of Publications;
4. To know the authorship pattern in different domains;
5. Dominant Collaborators and
6. To Rank the Communicated Journals.

Methods and Materials

Data set examined in this investigation was obtained from Web of Science (WoS) core collection database. The elementary data searched, which narrates the bibliometric features of Yoshino Akira, were obtained by using 'Author Search' option in WoS database, the search backed with the 480 documents which include Journal articles, proceedings paper, notes, editorials, corrections, letters, meeting abstracts for the time span from 1989 to 2020, each type of documents are saved in CSV file and then imported into MS-Excel for further analysis to satisfy the objectives of the study.

To make the data more convenient and easy to understand; VOSviewer software has been used, which is freely available computer software which assists in the visualization of data on co-authorship pattern and network, networking of keywords, the association among authors, countries, institutions, source titles of publications, citations and co-citation analysis. Based on the uploaded data into VOSviewer displays the bibliometric maps which are easy to understand the relationship of the author with different types of networks.

4.2.11. Analysis of Publication Productivity of Yoshino Akira

4.2.11.1. Publication Productivity of Yoshino Akira

It is observed from table 1 and figure 1 that Yoshino Akira has responsible to publish 480 publications in which 471 are multi-authored and 9 single-authored publications during his productive career. Out of 471 multi-authored publications more than ten- authored publications highest in number with (92), followed by five-authored (73), four-authored (63), seven-authored (57), and six-authored (56). With an average of 238 per year and 15 citations per publications Akira's publications receive a sum of 7372 citations. With an average of 15.5 per year which reaches at peak level at the age 70 and 71 with 28 publications in each year 2017 and 2018. From the table 1 it is inferred that Akira was very active in his productive career, with on an average of 15 publications per year, which shows his dedicative work to contribute in the field of chemistry, which results the emergence of new concepts which may solution for the problems arise. Publication in collaboration has more influence on society, for this reason Akira's authorship pattern follows multiple authorship rather than solo authored publications.

Table 1: Chronological Order of Publication Productivity of Yoshino Akira

AA	Year	Single v/s Multi-Authored Publications										MT	TP	%	TC	%	APL
		1	2	3	4	5	6	7	8	9	>10						
42	1989			4	1					1		6	6	1.25	45	0.61	1
43	1990				1			1				2	2	0.42	7	0.09	2
44	1991			1		2						3	3	0.63	593	8.04	3
45	1992			3	4	3	1					11	11	2.29	309	4.19	4
46	1993			2	1	4	1					8	8	1.67	330	4.48	5
47	1994			3		7	2	2				14	14	2.92	137	1.86	6
48	1995		2	1		2	1	1	1		1	9	9	1.88	283	3.84	7
49	1996		1		4		1	1				7	7	1.46	156	2.12	8
50	1997				2	4	2	1	3	1		13	13	2.71	141	1.91	9
51	1998		1	2	5	5		1	1			15	15	3.13	141	1.91	10
52	1999				5	3	2					10	10	2.08	236	3.20	11
53	2000	1	1	2	2	3				2	1	11	12	2.50	220	2.98	12
54	2001				2	2	4		1	1	2	12	12	2.50	693	9.40	13
55	2002	1		1	1	3	2	3	1		5	16	17	3.54	369	5.01	14
56	2003			1	2	4	3	1	1	1		13	13	2.71	467	6.33	15
57	2004	1	1	1	3	2		3	3	1	1	15	16	3.33	356	4.83	16
58	2005				3	3	3	5	4	2	2	22	22	4.58	563	7.64	17
59	2006		1		1		3	3	1		2	11	11	2.29	160	2.17	18
60	2007				5	1	2	1	2	4		15	15	3.13	440	5.97	19
61	2008	1	2		1	2	1	2	1	1	1	11	12	2.50	118	1.60	20
62	2009		1			2	2	3		1	3	12	12	2.50	113	1.53	21
63	2010	1	1	2	1	1	1	3	3	1	5	18	19	3.96	247	3.35	22
64	2011			2	2	1	1	4	2	2	1	15	15	3.13	61	0.83	23
65	2012	1	1		2	2	1	2		2	10	20	21	4.38	417	5.66	24
66	2013				2	3	4	4	1	3	9	26	26	5.42	144	1.95	25
67	2014	2		1	1	5	5	3	5	1	7	28	30	6.25	257	3.49	26
68	2015		1		1	2	1	1	2	3	6	17	17	3.54	73	0.99	27
69	2016			1	2	4	5	4	5	2	8	31	31	6.46	128	1.74	28
70	2017		1	1	7		2	3	4	2	8	28	28	5.83	134	1.82	29
71	2018	1		1	2	2	4	1	5	3	9	27	28	5.83	29	0.39	30
72	2019			3		1	2	4	4		11	25	25	5.21	5	0.07	31
Total		**9**	**14**	**32**	**63**	**73**	**56**	**57**	**50**	**34**	**92**	**471**	**480**	**100.00**	**7372**		

MT= Multiple Authors, TP= Total Publications, TC= Total Citations, APL= Age of Productive Life

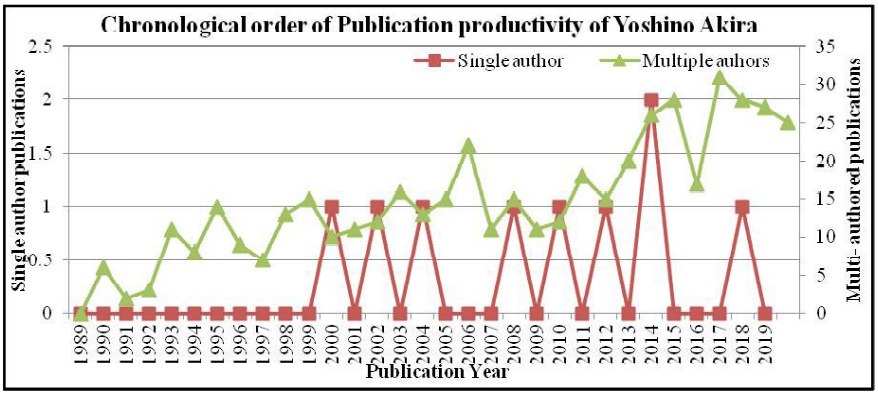


Figure 1: Year-wise distribution of publications of Yoshino Akira

4.2.11.2. Channels of Communications

Table 2 describes the channels of communications used by Yoshino Akira. He had 480 publications to his credit, in which 361 (75.20%) are journal articles, meeting abstract 68 (14.16%), letters 18 (3.75%), proceedings papers 17 (3.54%), notes 6 (1.25%), reviews 3 (0.62%) corrections 2 (0.41%). It is understood form table 2 that his research outcomes were scattered in different type of documents. Journal article are considered as the most common and convenient medium of communication for this reason Akira may preferred more Journal article as communication medium for communication of his publications rather than other medium.

Table 2: Channels of Communications of Documents

Document Type	No. of Papers
Journal Article	361
Article; Proceedings Paper	17
Correction	2
Editorial Material	5
Letter	18
Meeting Abstract	68
Note	6
Review	3
Total	**480**

4.2.11.3. Domains of Publications

Domains in publications of Yoshino Akira have been illustrated in table 3. Categorized 7 sub domains of chemistry. Medicinal chemistry is one of the dominant domains in which he had 224 publications; the second most dominant domain is biochemistry with 86 publications, 74 publications are in multidisciplinary domain, organic chemistry 59 publications, physical chemistry 20, inorganic chemistry 16 and pharmacology 1 publication. In table 3 it is observed that his research outcomes are scattered in almost all sub disciplines of the Chemistry, which shows his diversification in his research work. Akira has contributed more in the field of Medicinal Chemistry, which is backbone for the drug industry and has a responsibility to serve society by producing life saving drugs.

Table 3: Domains of publications of Yoshino Akira

Domains	TP	%	Citations	%
Biochemistry	86	17.92	2355	31.95
Inorganic Chemistry	16	3.33	240	3.26
Medicinal Chemistry	224	46.67	2549	34.58
Multidisciplinary	74	15.42	724	9.82
Organic Chemistry	59	12.29	1184	16.06
Pharmacology	1	0.21	5	0.07
Physical Chemistry	20	4.17	315	4.27
Total	**480**	**100**	**7372**	**100**

A=Biochemistry, B=Inorganic Chemistry, C=Medicinal Chemistry, D=Multidisciplinary, E=Organic Chemistry, F=Pharmacology, G=Physical Chemistry

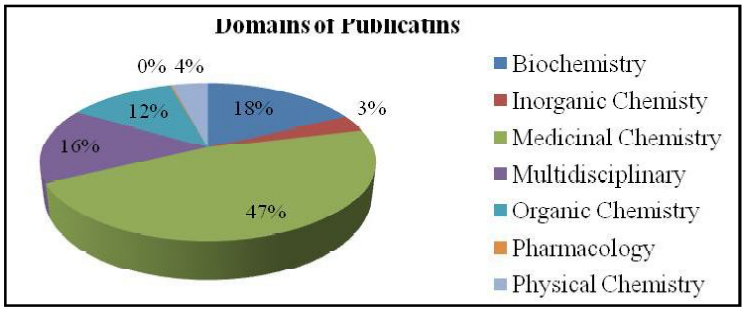


Figure 2: Domains of Publications

4.2.11.4. Authorship Pattern of Yoshino Akira in various Domains

Table 4: Domain-wise distribution of Authorship Pattern of Yoshino Akira

No. Authors	Domains of Publications							TP	No. of Authorship
	A	B	C	D	E	F	G		
1-Author		1	4		4			9	9
2-Authors	1	1	3	5	4			14	28
3-Authors	3	1	8	8	10		2	32	96
4-Authors	4	2	31	10	13		3	63	252
5-Authors	14	2	38	8	8		3	73	365
6-Authors	16	2	21	8	6		3	56	336
7-Authors	15	4	24	11	2		1	57	399
8-Authors	7	1	28	5	3	1	5	50	400
9-Authors	11	1	16	5			1	34	306
10-Authors	6		19	5	1			31	310
11-Authors	5		14	2			1	22	242
12-Authors	3		3	2	2			10	120
13-Authors			3	2	1			6	78
14-Authors			6	1				7	98
15-Authors			2					2	30
16-Authors			1	2	2			5	80
17-Authors	1						1	2	34
19-Authors		1						1	19
20-Authors			1					1	20
22-Authors			1					1	22
23-Authors					1			1	23
27-Authors					2			2	54
42-Authors			1					1	42
Total	**86**	**16**	**224**	**74**	**59**	**1**	**20**	**480**	**3363**

TP= Total Publications

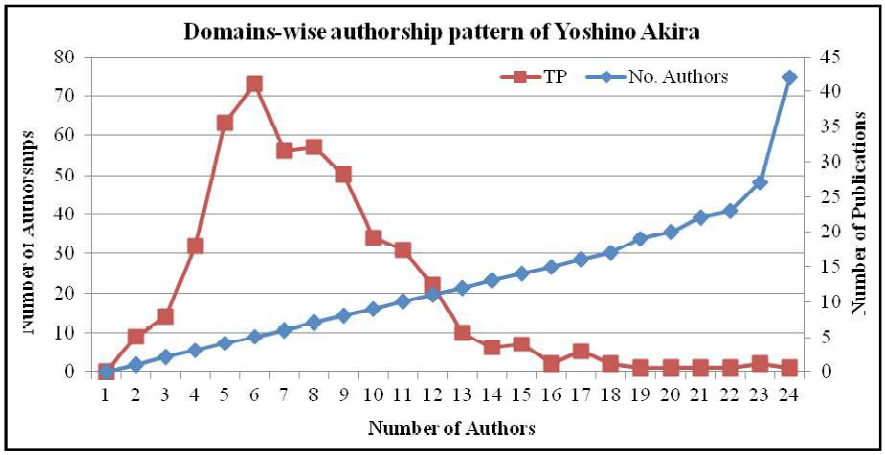


Figure 3: Authorship pattern of Yoshino Akira

Table 4 explains about the authorship pattern of Yoshino Akira. Domain-wise authorship pattern has been done which determine the single and multi-authored publications. It is noticed that the single authored publications are very less (9) while compare to multiauthored publications (471) which shows Akira beliefs in multi-authored publications. His authorship pattern was scattered over different domains i.e. Biochemistry (86), Inorganic Chemistry (16), Medicinal Chemistry (224), Multidisciplinary (74), Organic Chemistry (59), Pharmacology (1), and Physical Chemistry (20), and calculated the number authorship which has been accounts with 3363 authorship, in which 42 and 27 authored publications have been considered as high collaborated publications and found that five-authored publications are more in number with 73. Akira published his research works in all type of authorship patterns like Solo, Double, triple etc.his authorship pattern starts from minimum one to maximum 42 authors, multi-authored publications are have high which shows that his main aim is to communicate his works to common man's understand.

4.2.11.5. Domain-wise Authorship Credits of Researchers Collaborated with Yoshino Akira

Table 5 explains about the authorship credits of research collaborators of Yoshino Akira. His productive career he had collaborated with 1123 fellow researchers. Katayama Y is the most prolific author who has collaborated in highest number of publications accounts 92 with in a time span of 29 years (1991-2019) and more in Medicinal Chemistry domain with 52 publications, further he was followed by Watanabe T collaborated with Akira in 54 publications in seventeen years (1997-2013)in Medicinal Chemistry it was observed more of publications, Fukushima T collaborated in 45 publications during 2002-2016, Nomura S and Ohta T have collaborated in 41 publications each during the period of 1998-2019, 2005-2019 respectively. Ogino A in 36 publications, Okamoto Y in 34 publications. It was found that count of authorship credit for 1123 authors is 3363; every collaborator is being given each one authorship credit for each publication published. Yoshino Akira himself has shared 480/3363 of total authorship. Looking into below table 5 it was noticed that he has mega number of collaborators. Good academic relation and result oriented research leads the highest collaboration in publications, Akira feel more comfortable to publish his works in collaboration of Katayama which results dominant collaborator.

Table 5: Domain- wise Authorship Credits of Researchers Collaborated with Yoshino Akira

Sl. No.	Authors	Scientific Domains							Period	Time Span	No. of Authorship
		A	B	C	D	E	F	G			
1	Yoshino, A	86	16	224	74	59	1	20	1989-2019	31	480
2	Katayama, Y	31	1	52	6			2	1991-2019	29	92
3	Watanabe, T	23	2	25	4				1997-2013	17	54
4	Fukushima, T	21		21	3				2002-2016	15	45
5	Nomura, S	1	1	24	13	1		1	1998-2019	22	41
6	Ohta, T;	21		19	1				2005-2019	15	41
7	Ogino, A;	17		14	3	1		1	2005-2018	14	36
8	Okamoto, Y;	6		21	7				2009-2019	11	34
9	Yamawaki, S;		1	18	8				2004-2019	16	27
10	Yoshimura, S;	4		16	5	2			2010-2019	10	27
11	Takahashi, Y			13	9	2			1989-2019	31	24
12	Yachi, K;	14		8	1			1	2006-2014	9	24
13	Shigemura, J;		1	6	11				2001-2019	19	18
14	Komine, C	9		6	2				2003-2007	5	17
15	Nagamine, M;	1		9	7				2005-2019	15	17
16	Okabayashi, H;		1	1	1	11		3	1992-2001	10	17
17	Takahashi, K		1	1		14		1	1989-2019	31	17
18	Takami, A		3	3	3	4		4	2013-2019	7	17
19	Oshima, H;	1	1	11	1		2		1995-2018	24	16
20	Sano, E	9	1	5	1				2009-2019	11	16
21	Yokoyama, T	6		7	3				2003-2010	8	16
22	Yoshida, T		1	3	2	8		2	1989-2008	20	16
23	Shimizu, K	2	1	4	8				1997-2019	23	15
24	Tanichi, M;	1		4	10				2014-2019	6	15

25	Toda, H;	2		5	6	1		1	2015-2019	5	15
26	Yamamoto, T			11	2	1	1		2001-2019	19	15
27	Tatsuzawa, Y			9	5				1997-2017	21	14
28	Ueda, Y	1		11	1	1			1998-2019	22	14
29	Yamamuro, S;	3		10	1				2014-2019	6	14
30	Okada, G		1	8	4				2010-2019	10	13
31	Sakazume, S;	2		9	2				2001-2015	15	13
32	Hachiya, J	1		11					1993-2003	11	12
33	Kajii, Y	2	1			8		1	2004-2019	16	12
34	Kato, M			7	4	1			1992-2016	25	12
35	Kunisato, Y;		1	7	4				2010-2017	8	12
36	Nagai, T	1		10	1				2002-2015	14	12
37	Obata, K;	1	1	9	1				2002-2014	13	12
38	Sakatani, K	3		8	1				2007-2016	10	12
39	Tsuchiya, K;	1		10	1				1996-2003	8	12
40	Watanabe, M;			11			1		1997-2019	23	12
41	Maeda, T;		1	7	1			2	2014-2019	6	11
42	Mogi, T;			8	2			1	2012-2019	8	11
43	Watanabe, K	4		3		4			1997-2019	23	11
44	Homma, T;	4		5	1				2016-2019	4	10
45	Katase, S;	1		9					1998-2003	6	10
46	Kobayashi,			8			1	1	2001-2018	18	10
47	Murakami, N;	1		8	1				2002-2014	13	10
48	Remaining 1077 authors counts less than 10 authorships	331	76	927	284	244	5	95	1989-2019	31	1962
Total	**611**	**112**	**1626**	**505**	**362**	**11**	**136**				**3363**

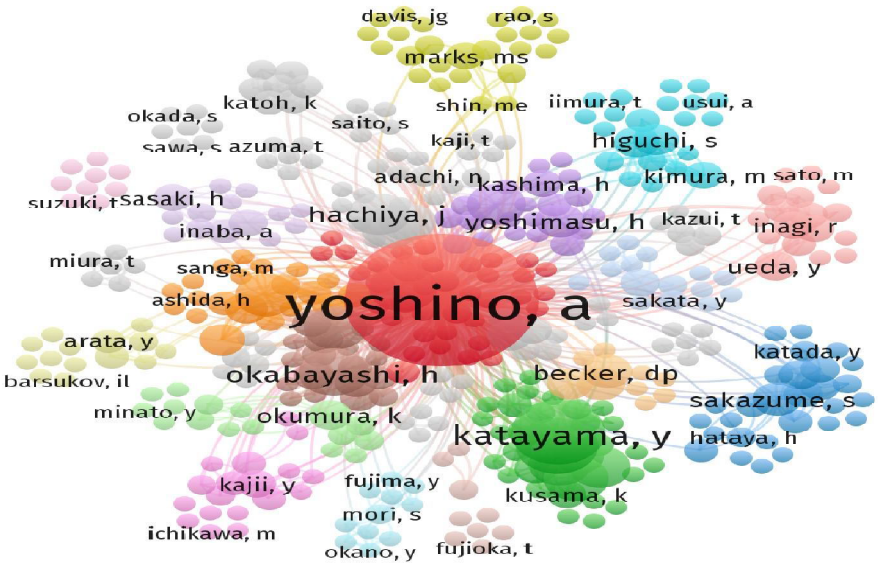


Figure 4 : Co-authorship network of Yoshino Akira

4.2.11.6. Ranking of Journals and Preferred for Publications by Yoshino Akira

Table 6 describes about the core journals preferred by Yoshino Akira to communicate his publications. Akira has used 235 source titles to publish his 470 papers receive 7325 citations. Among the source title Neuro-Oncology is most preferred journal with 21 publications during (2005-2018) it quite interesting that citations received by these publications were only one citation and having impact factor of 10.091, next followed by Psychiatry and Clinical Neurosciences with 16 publications in it during (2002-2019) and impact factor of 3.351, Bulletin of the Chemical Society of Japan with 12 publications receives 46 citations which is having impact factor of 4.488. Yoshino Akira's H-Index accounts with 44. It was found in the above table 6 that Akira has used 235 Source titles have been selected for communication of publications in which Journal of the Neuro-Oncology. By observing the Impact Factor of journals it is found that he has communicated his research output in wide verity and good quality of journals.

Table 6 : Ranking of Journals and Preferred for Publications by Yoshino Akira

Sl. No.	Journals	TP	Cum.	TC	Time Span	IF
1	Neuro-Oncology	21	21	1	2005-2018	10.1
2	Psychiatry And Clinical Neurosciences	16	37	97	2002-2019	3.35
3	Bulletin Of The Chemical Society Of Japan	12	49	46	1989-2009	4.49
4	Journal Of Neuro-Oncology	10	59	174	1999-2018	3.27
5	ActaNeurochirurgica	8	67	52	1994-2018	1.82
6	Alcoholism-Clinical And Experimental Research	8	75	223	1994-2015	3.04
7	American Journal Of Medical Genetics Part A	7	82	156	2005-2014	2.2
8	Brain Research	7	89	1023	1991-2016	2.73
9	Epilepsia	7	96	0	2004-2014	6.04
10	International Journal Of Oncology	7	103	133	2008-2019	3.57
11	Neurologia Medico-Chirurgica	6	109	120	2004-2017	1.65
12	Neuroscience Letters	6	115	92	1997-2016	2.27
13	Atmospheric Environment	5	120	104	2006-2016	4.04
14	Neuropathology	5	125	30	2006-2017	2.16
15	Pediatrics International	5	130	9	2011-2018	1.14
16	Plos One	5	135	44	2013-2019	2.87
17	Psychogeriatrics	5	140	4	2016-2019	1.75
18	Aerosol And Air Quality Research	4	144	23	2013-2019	2.74
19	Atmospheric Chemistry And Physics	4	148	96	2009-2017	5.67
20	Internal Medicine	4	152	3	2013-2016	4.6
21	Journal Of Hard Tissue Biology	4	156	23	2016-2017	0.62
22	Journal Of Neurosurgery	4	160	63	1995-1999	4.13
23	Journal Of Neurotrauma	4	164	9	2014-2018	3.75
24	Neuroscience Research	4	168	11	2011-2014	2.65
25	Stereotactic And Functional Neurosurgery	4	172	3	2013-2016	1.91
25	Other 210 journals publishing less than 4 publications each	298	470	4786	1989-2019	-
	Total	**470**		**7325**		

TP= Total Publications, TC= Total Citations, IF= Impact Factor

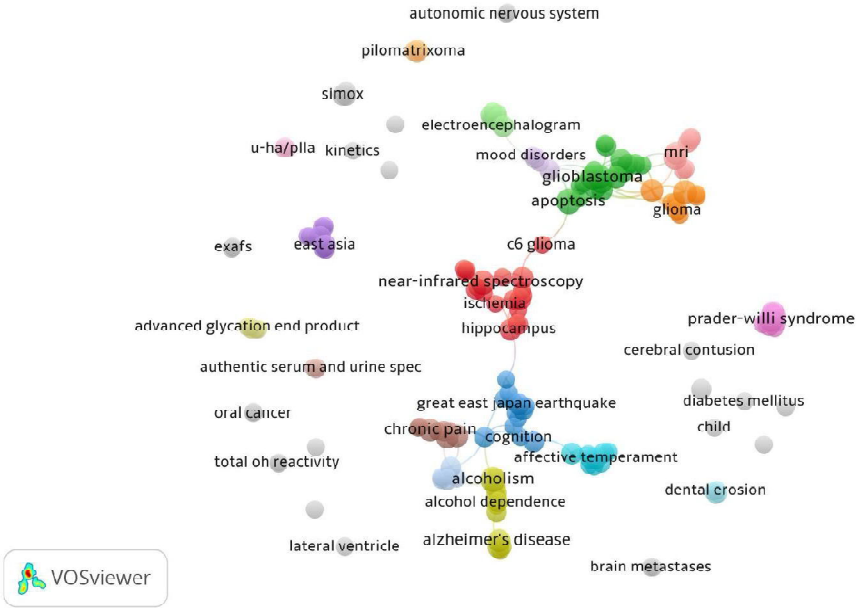


Figure 5: Co-occurrence of network map of keywords

4.2.11.7. Keyword Tomography

Keywords in the publications (Figure 5) are like guide, which convey the content that the investigation includes. Keywords reflect the interest/idea of the author, if the certain keywords are used repeatedly. The most periodic keywords which are reoccurred for two times are considered are: glioblastoma, prader-willi syndrome, alcoholism occurred each for 8 times, mgmt, brain tumour, growth hormone, near-infrared spectroscopy, pituitary adenoma each occurred for 7 times, methylation, temozolomide, chemotherapy, malignant glioma, cognitive behavioural therapy, alzhlimor's disease, chronic pain, fmri are occurred 5 time each.

Conclusion

The contributions of Nobel Laureate Yoshino Akira have made animpression on the various disciplines of Chemical sciences. The investigation presents the research produced by Akira. The above case of Scientometric decides a significant role in the scattering of particular scientist whose interest lies in the number of authentic papers he/ she have produced. Authorship particulars brief us that the enormous interest the author has taken to reach his work to end users understanding of Lithium-ion Batteries.

It is observed that Akira is responsible for producing of 480 publications with constant growth during his productive career. There was 7325 citations for 480 publications, and had the significant impact with the H-index of 44, Out of 480 publications 394 are resulted with multi-authorship pattern which shows that influence of multi-authored publications. “Katayama, Y”, “Watanabe, T” and”Fukushima, T” are found that the topmost collaborators. “Brain Research”, “Alcoholism-Clinical and Experimental Research”, and “Journal of Neuro-Oncology” are the 3 topmost source titles that have receives the most citations. There is no doubt the result of this bibliometric investigation on the scientific career of Akira has provided helpful insights.

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