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Significance of Google Scholar on Indian poultry science research

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Abstract
Google Scholar's contribution towards the progress of scientific research in Poultry Science of India was studied using the scientific journal, "The Indian Journal of Poultry Science" (IJPS). A Scientometric study of IJPS for 25 Years between 1995 to 2019 using the Publish or Perish (PoP) software platform was conducted. Raw data from Google Scholar was subjected to 19 citation indicators. Source, Papers, Citations, Years, Citations_year, Citations_paper, Citations_author, Papers_author, Author's_Paper, h_index, g_index, hc_index, hi_index, hi_norm, AWCR, AW_index, AWCRpA, e_index, hm_index, Query Date, Cites_Author_Year, Zipf's Law examined annual contributions, authorship patterns and author productivity trends in scholarly publications. IJPS relative growth and doubling time were also examined in this study. The year that saw the most articles is 2009, next was the year 2012 followed by 2000 and 2001.

Keywords: Google Scholar, Indian journal of poultry science, doubling time, relative growth rate, scientometric study, Zipf's law, author productivity

Introduction

Scientometrics is the study of quantitative aspects of scholarly literature like measurement of impact of research papers and academic journals, understanding of scientific citations and the use of such measurement in policy and management contexts. Derek De Solla Price is a pioneer of this subject that can aptly be called as "science of sciences". Scientometric analysis is a research method used to analyze scientific publications based on various parameters such as the number of publications, authorship, citations, journals, institutions and countries.

The primary objective of this study using Google Scholar was to understand the growth of Indian Journal of Poultry Science (IJPS) and contributor's research output during the period from 1995 to 2019 (25 Years). The specific objectives are.

- Analyze impact of IJPS on number of publication (productivity) through citation metrics.
- Study the distribution of articles and authorship patterns by year.
- Identify author collaboration, single and multi-authored papers by year.
- Find Relative Growth Rate (RGR) and doubling time of the articles over the study period.
- Determine the application of Zipf's Law of author's research productivity in IJPS.

Impact summaries of 920 articles from The Indian Journal of Poultry Science (IJPS) were analyzed using Google Scholar. Citations measure how often an article is cited in other publications, Years is the time duration of study from 1995 to 2019 which is 25 years. Citations Year is the number of times an article is cited in a year. Citations_ Paper is the total citations multiplied by the paper count. Citations author represents an average citations. Papers author shows each author's median publication count. Author's Paper calculates the number per paper. H index is Hirsch's (2005) [8] author level index calculated by counting the number of publications for which an author has been cited by other authors at least the same number of times. g index is an author level metric suggested by Leo Egghe (2006) [3]. The g index is the unique largest number such that the top g articles received together at least g^2 citations. If the g index is 10, it indicates that an author's top 10 publications have been cited at least 100 times, hc index, also called as the contemporary h index adds an age related weighting to each cited article. It gives less weighting for older articles. P o P uses gamma=4 and delta=1 for parametrizing. This means that if an article is published during the current year, its citation count is four times. For an article published 4 years ago, its citation counts only once. (4/4=1). For an article published 6 years ago, its citation count is 4/6 that is 0.67 only. hi index reduces co-authorship by dividing the standard h index by the average number of authors. hi index denotes individual h index. hi norm normalizes each paper's citations by dividing it's sources by its authors., Whilst hi norm accounts for co-

authorship effects, h index measures per-author impact. Jin (2007) [11] proposed the Age Weighted Citation Rate (AWCR) which is the number of citations of a given paper divided by the age of that paper, Newer papers with less number of citations can be included in the AWCR. AW index, is the square root of AWCR to allow comparison with the h index of the average citation rate that remains more or less constant over the years. AWCRpA is the per author AWCR that is similar to the plain AWCR but is normalized to the number of authors for each paper. P o P calculates the e index as the cube root of the number of h-set citations greater than h_2, the minimum needed for an h index of 'h'. The e index differentiates between authors with similar h indices and citation patterns. hm index, is a modification of the h index that takes into account multiple co-authorship into account. Fractional counting of the papers yields the hm index. Query Date, is the date on which information regarding the collection of data about IJPS was made (16th May, 2022). Citations Author Year, refers to the format of citing, name of the author is written with the year in parentheses. Indian Journal of Poultry Science publishes research papers on various aspects of Poultry Science like nutrition, management, products technology, toxicology, genetics, poultry pathology, immunology, biochemical studies and biotechnology etc.

Materials and Methods

The research data was collected from the online version of the Indian Journal of Poultry Science available in Publish or Perish, PoP (2022) during the period between 1995 to 2019 (25 years) and is used as the main source of information for the present study. PoP is a Microsoft Windows application that can also be installed and compatible with OS X, also referred to as Mac OS X (Macintosh Operating System) and Linux OS, with the aid of a suitable emulator such as cross over PoP, that retrieves and analyzes academic citations. The study uses Google Scholar (2022) to obtain the raw citations to analyze various metrics. Among the 920 articles considered for the study, research articles, short communication, reviews and case studies were included. As a final point, the data was organized, calculated, tabulated, analyzed and presented in the form of tables and graphs for the purpose of interpretation and discussion. Table 1 offers some parameters, in terms of various simple statistics (number of papers, number of citations and number of authors) and various other citation metrics of Indian Journal of Poultry Science.

Table 1: Impact for Indian Journal of Poultry Science

Query	Indian Journal of Poultry Science
Source	Google Scholar
Papers	920
Citations	4371
Years	25
Citations Year	161.89
Citations Paper	4.75
Citations Author	1390.23
Papers Author	290.9
Authors Paper	3.47
h index	22
g index	34
hc index	10
hi index	6.63
hi _norm	13
AWCR	321.03
AW index	17.92
AWCRpA	99.04
e index	21.14
hm index	15.78
Query Date	5/16/2022 8:53
Citations Author Year	51.49

Results and Discussion

According to Figure 1, the Indian Journal of Poultry Science published the most articles in 2009 (7.39%, or 68), next in 2012 (7.28%, or 67), and in 2000 and 2001 (6.30%, or 58).

Fig 1: Growth of Year wise Article in IJPS

Relative Growth Rate (RGR) is employed to find increase in the number of articles/ pages per unit of time. The mean Relative Growth Rate over specific period of interval can be calculated from the following equation (Hunt & Cornelissen, 1997) [9].

$$\text{Relative Growth Rate (RGR)} = \frac{\text{Log}X_eW_2 - \text{Log}X_eW_1}{T_2 - T_1}$$

RGR = Mean relative growth rate over the specific period interval.
$\text{Log}X_eW_1$ = Log of initial number of articles.
$\text{Log}X_eW_2$ = Log of final number of articles a specific period of interval.
$T_2 - T_1$= Unit difference between the initial time and the final time.

In this study, year is taken as unit of time for calculation of RGR.

Doubling Time (DT)

The parameter Doubling Time (DT) is directly related to RGR and indicates the time required for publications to become double of the existing volume. Doubling Time is unit for exponential growth equation. The Doubling Time is computed as follows.

$$\text{Doubling Time} = {(t_2 - t_1)\log(2)}/{(logc_2 - logc_1).}$$

Again, in the per year growth case, the expression for Doubling Time can be written as: Doubling Time$= \frac{\log(2)}{RGR}$.

The data relating to the growth output of Indian Journal of Poultry Science has been presented in Table 2. To calculate the mean RGR and mean DT the study period (1995-2019) has been divided into two block periods, i.e. 1995-2007 and 2008-2019. The quantum output of Indian Journal of Poultry Science has decreased from 19 in the year 1995 to 17 in the year 2019. However, research publication were found to be maximum in the year 2009 with 68 publications. It is further observed that the mean Relative Growth Rate increased from 1.659023 in the first block to 2.414113 in the second block. On the other hand, mean Double Time decreased from 0.5325569 in the first block to - 31.6316 in the second block. In addition, Relative Growth Rate increased from 3.044522 in the year 1999 to 3.402861 in the year 2017; correspondingly Double Time gradually decreased from 2.243007 in the year 2000 to 0.334199 in the year 2009 period.

Table 2: Relative Growth Rate and Doubling Time of Indian Journal of Poultry Science

Year	Quantum of Output	Cumulative total out put	LogXeW1	LogXeW2	RGR	Block Period	Double time	Block Period
1995	19	19	2.9444	2.944439	0		0	
1998	1	20	0.0000	2.995732	2.995732		0.231362	
1999	1	21	0.0000	3.044522	3.044522		0.227655	
2000	58	79	4.0604	4.369448	0.309005		2.243007	
2001	58	137	4.0604	4.919981	0.859538		0.806363	
2002	53	190	3.9703	5.247024	1.276732	1.6590223	0.54287	0.5325569
2003	50	240	3.9120	5.480639	1.568616		0.441854	
2004	47	287	3.8501	5.659482	1.809335		0.383069	
2005	49	336	3.8918	5.817111	1.925291		0.359998	
2006	38	374	3.6376	5.924256	2.28667		0.303105	
2007	48	422	3.8712	6.045005	2.173804		0.318842	
2008	51	473	3.9318	6.159095	2.22727		0.311188	
2009	68	541	4.2195	6.293419	2.073912		0.334199	
2010	53	594	3.9703	6.386879	2.416587		0.286809	
2011	57	651	4.0431	6.47851	2.435458		0.284587	
2012	67	718	4.2047	6.57647	2.371777		0.292228	
2013	47	765	3.8501	6.639876	2.789728	2.4141125	0.248447	-31.6316
2014	52	817	3.9512	6.705639	2.754395		0.251634	
2015	48	865	3.8712	6.76273	2.891528		0.2397	
2016	37	902	3.6109	6.804615	3.193697		0.217021	
2017	1	903	0.0000	6.805723	3.402861		0.203682	
2019	17	920	2.8332	6.824374	-0.00198		-350.617	

Authorship Pattern in Indian Journal of Poultry Science

The authorship trend in papers published in the Indian Journal of Poultry Science is seen in Table 3. There are 920 articles, both single- and multi-authored, written by 3193 authors. The table reveals that 149 authors (16.20%) published in 2004 with three single authors and 173 authors (18.80%) in 2000 with 40 two authors found. It also reveals that 78 authors (25.65%) published in 2009 with 78 three authors found, 255 authors (27.72%) published in 2012 with the majority of 160 four authors, and 207 authors (22.50%) published in 2014 with five and above 60 authors found.

Table 3: Authorship Pattern in Indian Journal of Poultry Science

S. No	Year	Single	Two	Three	Four	Five and above	Total	Percentages
1	1995	0	10	36	8	0	54	5.87
2	1996	0	0	0	0	0	0	0.00
3	1997	0	0	0	0	0	0	0.00
4	1998	1	0	0	0	0	1	0.11
5	1999	1	0	0	0	0	1	0.11
6	2000	2	40	42	84	5	173	18.80
7	2001	2	20	48	112	10	192	20.87
8	2002	0	20	54	92	10	176	19.13
9	2003	0	10	36	124	10	180	19.57
10	2004	3	14	54	68	10	149	16.20
11	2005	1	20	57	72	5	155	16.85
12	2006	1	14	36	60	15	126	13.70
13	2007	1	10	39	104	15	169	18.37
14	2008	1	14	48	92	20	175	19.02
15	2009	0	14	78	124	20	236	25.65
16	2010	0	14	30	112	40	196	21.30
17	2011	0	10	60	108	25	203	22.07
18	2012	1	8	36	160	50	255	27.72
19	2013	1	8	30	124	5	168	18.26
20	2014	0	2	33	112	60	207	22.50
21	2015	0	6	36	104	35	181	19.67
22	2016	0	10	30	72	20	132	14.35
23	2017	0	2	0	0	0	2	0.22
24	2018	0	0	0	0	0	0	0.00
25	2019	0	4	9	44	5	62	6.74
Total		15	250	792	1776	360	3193	347.07
Percentages		1.63	27.17	86.09	193.04	39.13	347.07	

Authors Collaboration in Indian Journal of Poultry Science

In this study, where Degree of Collaboration $C = \frac{Nm}{Nm+Ns}$

Ns = Total Number of Single Authors
Nm = Total Number of Multiple Authors
C = Degree of Collaboration

C= 3178/3178+15 = 1.00

The outcome is that the Degree of Collaboration grade is 1.00. In Table 4, statistics on the level of collaboration between single and multi-authored studies during the study period are displayed. 920 research publications included contributions from just 15 authors, while 3178 had many contributors.

Table 4: Degree of Collaboration during the study period in Indian Journal of Poultry Science

S. No	Year	Single (Ns)	Multiple Authors (Nm)	Total	Degree of Collaboration
1	1995	0	54	54	1.00
2	1996	0	0	0	0.00
3	1997	0	0	0	0.00
4	1998	1	0	1	0.00
5	1999	1	0	1	0.00
6	2000	2	171	173	0.99
7	2001	2	190	192	0.99
8	2002	0	176	176	1.00
9	2003	0	180	180	1.00
10	2004	3	146	149	0.98
11	2005	1	154	155	0.99
12	2006	1	125	126	0.99
13	2007	1	168	169	0.99
14	2008	1	174	175	0.99
15	2009	0	236	236	1.00
16	2010	0	196	196	1.00
17	2011	0	203	203	1.00
18	2012	1	254	255	1.00
19	2013	1	167	168	0.99
20	2014	0	207	207	1.00
21	2015	0	181	181	1.00
22	2016	0	132	132	1.00

23	2017	0	2	2	1.00
24	2018	0	0	0	0.00
25	2019	0	62	62	1.00
Total		15	3178	3193	1.00

Number of Citation per Articles in Indian Journal of Poultry Science

Table 5 provides data on citations per article. The table reveals that in 2004, with 47 (5.11%) of the documents, almost 447 (10.23%) citations were received for articles. This was followed by 354 (8.10%) citations in 2000 with 58 (6.30%) of the documents, and 319 (7.30%) citations in 2005 with 49 (5.33%) of the documents. However, (DeGroote, 2022) [2] the process of assessing an article's impact or "quality" by counting the number of times other authors mention it in their work and (Ahmed *et al*., 2016) [1] citation metrics and total publications in a field has become the gold standard for rating researchers and field viability.

Table 5: Number of Documents Vs Number of Citations

Year	Publications	%	Citation	%
1995	19	2.07	383	8.76
1998	1	0.11	6	0.14
1999	1	0.11	5	0.11
2000	58	6.30	354	8.10
2001	58	6.30	268	6.13
2002	53	5.76	231	5.28
2003	50	5.43	249	5.70
2004	47	5.11	447	10.23
2005	49	5.33	319	7.30
2006	38	4.13	190	4.35
2007	48	5.22	205	4.69
2008	51	5.54	240	5.49
2009	68	7.39	314	7.18
2010	53	5.76	207	4.74
2011	57	6.20	150	3.43
2012	67	7.28	232	5.31
2013	47	5.11	277	6.34
2014	52	5.65	111	2.54
2015	48	5.22	104	2.38
2016	37	4.02	69	1.58
2017	1	0.11	3	0.07
2019	17	1.85	7	0.16
Total	920	100.00	4371	100.00

Authors Rank in Zipf's Law Derivation

Zipf's Law is a reflection-based statement rather than a concept-based statement. Many sorts of data analyzed in Natural and Social science can be characterized by a Zipf distribution, which is actually a discrete probability distribution, according to Zipf's law, which was defined using mathematical statistics (George K., 1950) [4]. If all unique words in a text are organized (or ranked) in decreasing frequency of occurrence, the product of frequency time's rank provides a constant that is roughly identical for all terms in the text, according to Zipf. Assume that a word appears a particular number of times and that its rank in the list of word frequencies is r. Then if Zipf's Law holds (for all words) $f = a/rb$ where a and b are constants and b is close to 1(Hermetic, 2022) [7], Zipf's law then predicts that out of a population of N elements, the frequency of elements of rank k, f (k; s, N), is.

$$(k, s, N) = 1/ks \sum \left(\frac{1}{ns}\right) Nn = 1$$

N: be the number of elements;
K: be their rank;
S: be the value of the exponent characterizing the distribution

Figure 2 shows the findings of a study published in the Indian Journal of Animal Nutrition to determine the validity of Zipf's law, which gives a rank frequency distribution in data sets such as author's names. The graph (Figure.2) shows the ranked distribution of authors' names related to the number of publications as searched through Google using IJPS. Out of a total of 1060 names, "Singh" (220) is the most frequent, followed by "Kumar" (112). The terms "Sharma" appear 74, times in total. In spite of application of Zipf's law certain errors have been observed in this present study. Reasons for these errors are, the author name 'Singh' is actually a surname in the Indian context. The first and middle names of the author are written as initials in capital letters, for instance, S.K. Singh, and M.R.Singh etc. This error can partially be corrected by writing the first and middle names of the author in full, for example, 'Sanjay Kumar Singh'. However, that said, there still can exist two different authors with the same name *viz*., 'Sanjay Kumar Singh'. To totally eliminate this error, ORCID number of individual authors may be quoted. The ORCID (2022) number means Open Researcher and Contributor ID that is a nonproprietary alphanumeric code to uniquely identify authors and contributors. The most authentic feature of ORCID is it asks for the author's email ID. An author cannot have two email IDs within the same email service provider. Only one email ID is accepted for ORCID registration so that there is no error in authors' names. Further results generated from PoP software correlate positively with corresponding results of Zipf's law.

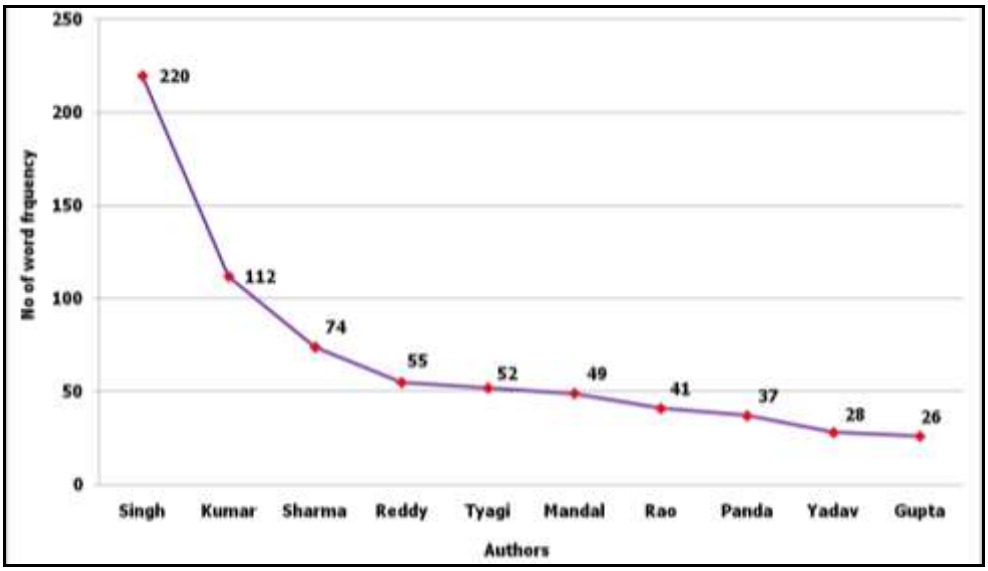

Fig 2: Top Authors Ranking through Zipf law

Conclusion

This study could pave way for more research on the usefulness of academic research publications and the productivity of authors who have contributed them. The scope of research and authorship distributions across a number of topics of interest, as well as joint authorship, should be the focus of future research. This type of research would be useful in the development of new research. From 1995 to 2019, data from the Indian Journal of Poultry Science NAAS (2022) grade of 5.85 was effectively investigated and analyzed. The report discusses the expansion of IJPS, citation frequency, authors, degree of collaboration, and Zipf's law for author productivity. Single impact journal study is very much required to the editor to decide the future management of the journal. We suggest that every five years, single journal impact study must be conducted. Creating awareness about ORCID registration for authors is of paramount importance. Further, it may be made mandatory for contributing authors to provide ORCID number.

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