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# Applications Of Bradford's Law Of Scattering And Leimkuhler Model To Neurochemistry Research Output At Global Level

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**Abstracts**

The present study based on the applications of Bradford law and Leimkuhler model of Neurochemistry research output at global level. In this study period, scientists have contributed 3232 research publications scattered over 983 journals during 1989-2020. It was seen that the analyses included growth of neurochemistry publications, journal wise distribution of publications, tested the Bradford law of distribution and also verified Leimkuhler model. This study shows that "Journal of Neurochemistry" is the most productive journal. The verification of Bradford law and Leimkuhler model is not fit.

**Keywords**: Scientometrics, Bibliometrics, Bradford law, Leimkuhler model, Neurochemistry, Research Productivity.

## 1. Introduction:

Neurochemistry is the study of chemicals and their reactions in the nervous system. Potentially a tremendously broad field, neurochemistry could encompass nearly all the anatomy and physiology of the central and peripheral nervous systems. Research is the most important intellectual activity in the higher education. Researchers develop new knowledge which ensures development of a subject. The researchers using various resources for their research work in the field of interest. The journals are the main source of information to get the new ideas of research work. The refereed journals are relevant and clearly reflect the conceptual essence of the research being carried out in the discipline. This study is an attempt to assess the Neurochemistry research output trends at global level indexed in the web of science database.

## 2. Objectives:

The present study was undertaken with the following objectives

1. To identify the growth of publications
2. To find the core journals of Neurochemistry research output
3. To verify the applications of Bradford Law of scattering
4. To verify the Leimkuhler model

## 3. Methodology

This study conducted the applications of Bradford law and Leimkuhler model. The data downloaded from web of science database during 1989-2020. Totally 3232 publications were published during the study period. The data has analyzed and classified into Histcite software. Then the bibliographical details are converted to the form of MS-Excel format.

## 4. Analysis and Discussion

### 4.1 Growth of Research Output and Citation:

In the present study the research output on Neurochemistry publications taken as a tool to evaluate the performance at various levels. Table 1 could clearly see that during the period 1989-2020 a total of 3232 publications were published at global level. The highest publication is 161 with 1122 global citation score in the year of 2019 followed by 155 publications 1763 citations in 2018. The lowest publication is 19 with 367 Global Citation Scores. It shows that even minimum numbers of publications were scored higher global citations.

**Table 1: Year wise distribution of publications**

| S.No | Publication Year | Publications | % | TLCS | TGCS |
|---|---|---|---|---|---|
| 1 | 1989 | 19 | 0.6 | 18 | 367 |
| 2 | 1990 | 31 | 1 | 19 | 942 |
| 3 | 1991 | 61 | 1.9 | 57 | 3490 |
| 4 | 1992 | 71 | 2.2 | 63 | 2133 |
| 5 | 1993 | 55 | 1.7 | 37 | 2399 |
| 6 | 1994 | 61 | 1.9 | 66 | 2579 |
| 7 | 1995 | 85 | 2.6 | 58 | 3741 |
| 8 | 1996 | 83 | 2.6 | 59 | 4091 |
| 9 | 1997 | 88 | 2.7 | 75 | 3091 |
| 10 | 1998 | 94 | 2.9 | 75 | 5410 |
| 11 | 1999 | 75 | 2.3 | 59 | 5687 |
| 12 | 2000 | 85 | 2.6 | 64 | 4390 |
| 13 | 2001 | 89 | 2.8 | 69 | 4863 |
| 14 | 2002 | 81 | 2.5 | 62 | 4603 |

| | | | | | |
|---|---|---|---|---|---|
| 15 | 2003 | 85 | 2.6 | 68 | 5666 |
| 16 | 2004 | 107 | 3.3 | 69 | 6210 |
| 17 | 2005 | 98 | 3 | 100 | 6702 |
| 18 | 2006 | 96 | 3 | 56 | 5044 |
| 19 | 2007 | 105 | 3.2 | 101 | 6379 |
| 20 | 2008 | 105 | 3.2 | 90 | 6025 |
| 21 | 2009 | 112 | 3.5 | 86 | 4307 |
| 22 | 2010 | 124 | 3.8 | 76 | 5851 |
| 23 | 2011 | 106 | 3.3 | 79 | 5868 |
| 24 | 2012 | 130 | 4 | 53 | 5388 |
| 25 | 2013 | 159 | 4.9 | 97 | 5667 |
| 26 | 2014 | 138 | 4.3 | 69 | 3582 |
| 27 | 2015 | 147 | 4.5 | 65 | 3758 |
| 28 | 2016 | 149 | 4.6 | 65 | 3878 |
| 29 | 2017 | 133 | 4.1 | 30 | 2243 |
| 30 | 2018 | 155 | 4.8 | 28 | 1763 |
| 31 | 2019 | 161 | 5 | 16 | 1122 |
| 32 | 2020 | 144 | 4.5 | 5 | 376 |
| | **Total** | **3232** | | | 127615 |

### 4.2 Journal wise distribution of publications:

In accordance with this, the author has ranked according to the highest contribution of publications in the field of Neurochemistry. It is identify the table 2 the out of 983 journals, " Journal of Neurochemistry' has published 142 publications with 2918 Global citations, followed by Brain Research has 56 publications with 1991 Global citations and Journal of Comparative Neurology and Neuroscience have 53 publications with 2037 and 2361 global citations**.**

**Table 2: Journal wise distribution of Neurochemistry research publications**

| S.No | Journal | Publication | TLCS | TGCS |
|---|---|---|---|---|
| 1 | Journal of Neurochemistry | 142 | 76 | 2918 |
| 2 | Brain Research | 56 | 44 | 1991 |
| 3 | Journal of Comparative Neurology | 53 | 51 | 2037 |
| 4 | Neuroscience | 53 | 27 | 2361 |
| 5 | Neurochemical Research | 51 | 13 | 844 |
| 6 | Neuropsychopharmacology | 51 | 33 | 3307 |
| 7 | Psychopharmacology | 48 | 71 | 3135 |
| 8 | Behavioural Brain Research | 46 | 45 | 2022 |

| | | | | |
|---|---|---|---|---|
| 9 | Investigative Ophthalmology & Visual Science | 41 | 8 | 193 |
| 10 | Pharmacology Biochemistry And Behavior | 41 | 61 | 1629 |
| 11 | Biological Psychiatry | 39 | 56 | 2813 |
| 12 | Neurochemistry International | 31 | 6 | 752 |
| 13 | Physiology & Behavior | 30 | 10 | 1165 |
| 14 | Alcoholism-Clinical and Experimental Research | 27 | 27 | 953 |
| 15 | Journal of Neuroscience | 27 | 37 | 2412 |
| 16 | Neuropharmacology | 23 | 4 | 858 |
| 17 | Angewandte Chemie-International Edition | 22 | 17 | 1028 |
| 18 | European Neuropsychopharmacology | 22 | 3 | 277 |
| 19 | Neuroscience and Biobehavioral Reviews | 22 | 21 | 2421 |
| 20 | Neuroscience Letters | 22 | 12 | 904 |
| 21 | European Journal of Pharmacology | 21 | 12 | 913 |
| 22 | Neurotoxicology and Teratology | 21 | 19 | 753 |
| 23 | Progress in Neuro-Psychopharmacology & Biological Psychiatry | 20 | 17 | 416 |
| 24 | ACS Chemical Neuroscience | 19 | 6 | 321 |
| 25 | Brain Research Bulletin | 18 | 9 | 437 |
| 26 | Psychiatry Research-Neuroimaging | 18 | 28 | 467 |
| 27 | Developmental Brain Research | 17 | 9 | 730 |
| 28 | European Journal of Neuroscience | 17 | 6 | 615 |
| 29 | Journal of Psychopharmacology | 17 | 10 | 588 |
| 30 | Plos One | 17 | 0 | 201 |

### 4.3 Bradford's law of distribution

Table 3 indicates the first 36 journals covered more than one third of the total articles published. Next 228 journals covered next one third of the published articles. The last 719 journals are covered the last one third of the articles. It is evidence from the above ratio that the number of journals in each zone is not increasing geometrically. According to Bradford's distribution of the relationship between the zones is $1:a:a^2$ while the relationship in each zone between the present study is 36:228:719 which does not fit into Bradford distribution.

**Table 3 shows Bradford law of distribution**

| S. No | No. of journals | No. of contribution | Total Number of contribution | Cumulative Total |
|---|---|---|---|---|
| 1 | 1 | 142 | 142 | 142 |
| 2 | 1 | 56 | 56 | 198 |

| | | | | |
|---|---|---|---|---|
| 3 | 2 | 53 | 106 | 304 |
| 4 | 2 | 51 | 102 | 406 |
| 5 | 1 | 48 | 48 | 454 |
| 6 | 1 | 46 | 46 | 500 |
| 7 | 2 | 41 | 82 | 582 |
| 8 | 1 | 39 | 39 | 621 |
| 9 | 1 | 31 | 31 | 652 |
| 10 | 1 | 30 | 30 | 682 |
| 11 | 2 | 27 | 54 | 736 |
| 12 | 1 | 23 | 23 | 759 |
| 13 | 4 | 22 | 88 | 847 |
| 14 | 2 | 21 | 42 | 889 |
| 15 | 1 | 20 | 20 | 909 |
| 16 | 1 | 19 | 19 | 928 |
| 17 | 2 | 18 | 36 | 964 |
| 18 | 4 | 17 | 68 | 1032 |
| 19 | 2 | 16 | 32 | 1064 |
| **20** | **4 (36)** | **15** | **60** | **1124 (1077.33)** |
| 21 | 3 | 14 | 42 | 1166 |
| 22 | 6 | 13 | 78 | 1244 |
| 23 | 3 | 12 | 36 | 1280 |
| 24 | 4 | 11 | 44 | 1324 |
| 25 | 7 | 10 | 70 | 1394 |
| 26 | 10 | 9 | 90 | 1484 |
| 27 | 16 | 8 | 128 | 1612 |
| 28 | 10 | 7 | 70 | 1682 |
| 29 | 27 | 6 | 162 | 1844 |
| 30 | 25 | 5 | 125 | 1969 |
| 31 | 39 | 4 | 156 | 2125 |
| **32** | **78(228)** | **3** | **234** | **2359 (2154.66)** |
| 33 | 154 | 2 | 308 | 2667 |
| 34 | 565(719) | 1 | 565 | 3232 |
| **Total** | **983** | | **3232** | |

### 4.4 Bradford's Distribution of Journals in various zone analysis

Table 4 shows that the observation of small groups of 36 journals identified to the core zone representing 3.66% of journals covered 1124(34.68%) publications. The second larger group of 228 (23.19%) journals which is covered 1235 (38.21) publications and the third largest group zone

have 719 (73.14%) journals contribute 873 (27.01%) publications. The multiplier factor between zone 1 and zone 2 is 6.33 while it is 3.15 between zone 2 and zone 3. The average value is 4.74.

**Table 4 Bradford's Distribution of Journals in various zone analysis**

| Zone | No. of Journals | No. of Publications | Multiplier factor |
|---|---|---|---|
| Z1 | 36 (3.66) | 1124(34.68) | |
| Z2 | 228 (23.19) | 1235(38.21) | 6.33 |
| Z3 | 719 (73.14) | 873(27.01) | 3.15 |
| **Total** | **983 (100)** | **3232 (100)** | **4.74** |

### 4.5 Applications of Leimkuhler Model

According to this law there are small numbers of a journal which produce maximum number of publications constitute of core journals.

A= 3232 (Total number of articles)

$y_m$ = 142 (number of items in most productive source)

T= 983 (Total Number of journals)

p = 3 (Number of zones in which the data has to be divided)

$y_0$ = A/p = 3232/3 = 1077.33 = 1077 (approx.)

$k = (1.781 \times 3232)^{1/3} = (5756.19)^{1/3} = 17.92 = 18$ (approx)

$r_0 = T(k-1)/(k^p-1) = 983(18-1)/(18^3-1) = 16711/5833 = 2.86$

$a = y_0/\log k = 1077/\log 17.92 = 1077/1.25 = 861.6$

$b = k-1/r_0 = 17.92-1/2.86 = 5.92$

$r_1 = 2.86*17.92 = 51.25$

$r_2 = 2.86*(17.92)^2 = 918.42$

Hence, $2.86: 2.86*17.92: 2.86*(17.92)^2 = 1064.995$

$$\text{Percentage of error} = \frac{1064.995 - 983}{983} \times 100 = 8.34\%$$

Hence, it can be found that the above calculation that the percentage of error is significant and the percentage of error are little bit high. So the Leimkuhler model is not fit for present data.

## 5. Major Findings

1. The finding of the growth of publications of Neurochemistry research output brings out the highest publications was published in the year of 2019, 2018, 2016 and rest of the others. The study also reveals all these 3232 publications have 127615 cited references and it shows that a healthy trend in citing references is found among the scientists who belong to Neurochemistry.
2. The findings of the most productive journal is out of 983 journals, "Journal of Neurochemistry' has published 142 publications with 2918 Global citations, followed by Brain Research has 56 publications with 1991 Global citations.
3. The findings of the first the first 36 journals covered more than one third of the total articles published. Next 228 journals covered next one third of the published articles. The last 719 journals are covered the last one third of the articles. According to Bradford's distribution the relationship between the zones is 1: a: $a^2$ while the relationship in each zone between the present study is 36:228:719 which does not fit Bradford's distribution.
4. It can be found that the Leimkuhler model is not fit for present data .

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