A bibliometric analysis of Acta Pharmaceutica Hungarica (1965-2018)

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Abstract:
Aims: *The aim of this study is present a general overview of the journal from 1965 to 2018 using bibliometric indicators.*
Methods: *The data analyzed in this study, was extracted from the Scopus database. The information was exported in RIS file format to the Harzing's Publish or Perish and VOSviewer software for data analysis.*
Results: *The number of documents published in APH during the study period was 1868, the most frequently published document type was „original article". Articles published APH were cited 2555 times overall, averaging 1.37 citations per each paper. The highest number of articles published in collaboration was in 2007 and 2018 (16.7%). Overall, the period between 1981-2000 was the most fruitful, while the following years saw a decline in the number of articles. Clusters and co-occurrence networks of the authors keyowrds of the published documents were generated.*
Conclusion: *APH manages to reach a very wide audience of the Hungarian scientific community of researchers. Additionally, an evolution on the research topics covered by the journal could be observed, providing a contemporary overview of the pharmaceutical sciences. The submission of additional articles to the journal is highly encouraged to widen the reach of this journal towards international audiences.*

Keywords: *Acta Pharmaceutica Hungarica, bibliometric analysis, pharmaceutical science, citation, cluster analysis*

1. Introduction

Acta Pharmaceutica Hungarica (APH) was founded by the Hungarian Society for Pharmaceutical Sciences (MGYT) together with its sister journal, *Gyógyszerészet (Pharmacy)*. While the latter is a monthly publication, which aims to assist pharmacists in education, continuous professional development, highlighting relevant literature and to inform about professional affairs, both in Hungary and on an international scale, APH is quarterly, research-oriented journal, reporting on the experimental results of laboratories involved in pharmaceutical science [1,2]. Bibliometrics is an area of science, which is concerned with the qualitative and quantitative assessment of research, that is often used to evaluate the impact of journals, institutions, study groups or individual scientists [3,4]. The bibliometric analysis of a given journal may be important for various reasons; university libraries often evaluate these characteristics before including journals in their collection. Furthermore, authors study commonly known bibliometric parameters (e.g., number of publications per year, impact factor, CiteScore, h-index) before submitting a manuscript to a journal [5,6]. Hence, the present study aims to give a general bibliometric overview of APH in a 53-year period (1965-2018), since the journal was listed by international content indexing services.

2. Materials and methods

The data analyzed in this study, dating between 1965 and 2018 was extracted from the Scopus database on the 15th of October 2018. The information was exported in RIS (Research Information Systems, Incorporated) file format to the Harzing's Publish or Perish 6.35 software for data analysis [7,8]. In addition, VOSviewer 1.6.9 software was used to generate the collaboration and word co-occurrence networks from the recovered data [9].

3. Results

The total number of documents published in APH during the study period (1965-2018) was 1868, the number of papers published since 2001 decreased by 46.31-47.11% compared to the two previous periods (*Table I*) The most frequently published document type indexed by Scopus was „*original article*" (n=1710, 91.54%), followed by „*review*" (n=114, 6.10%;

Table I *General bibliometric characteristics of APH between 1965-2018*

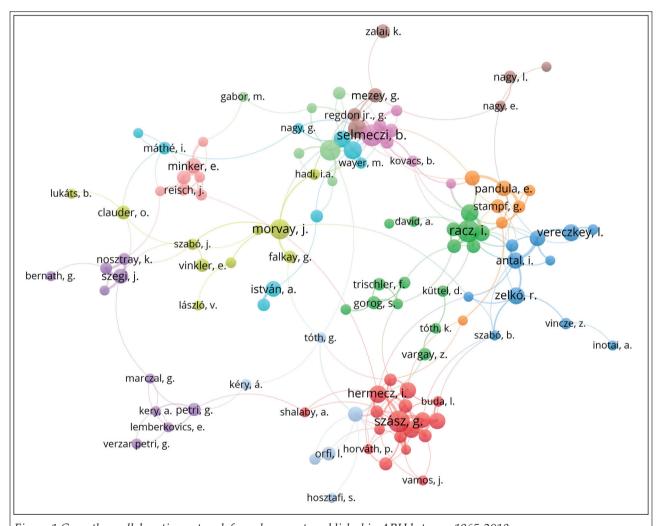| Publication years	1965-1980	1981-2000	2001-2018	Overall
Number of papers	743 (39.77%)	732 (39.19%)	393 (21.04%)	1868
Citations on the papers during the study period (1965-2018)	600 (23.48%)	1463 (57.26%)	492 (19.26%)	2555
Cites per year	11.32	39.54	28.94	48.21
Cites per paper	0.81	2.00	1.25	1.37
Authors per paper	2.36	3.06	3.47	2.87
h-index	8	14	10	14

Figure 1 *Co-author collaboration network from documents published in APH between 1965-2018*

first occurrence in 1991), „*short survey*" (n=24, 1.28%; first occurrence in 1990) and 18 „*conference paper*" (n=18, 0.96%; first occurrence in 1989). There was only one paper classified as an „*editorial*" (in 2011 [10]) and an „*erratum*" (in 2003), respectively. The average amount of authors per paper increased consistently throughout the years (2.36-3.47; *Table I*).

Regarding the impact of papers in APH, articles published between 1965 and 2018 were cited 2555 times overall, averaging 1.37 citations per each pa-

per, with more than 57% of overall citations on articles published in the period between 1981-2000. The average ratio of self-citations was 26.76% (0-69.23%; highest in 2001). The papers with high amount of citations (defined as 15 or more cites) correspond to 12.13% of total citations (8.86 citations per year, 140.99 cites/author) for APH (articles listed in *Table II*). The journal is associated with two subject categories, namely *Medicine (miscellaneous)* and *Pharmaceutical sciences*. Based on the in-
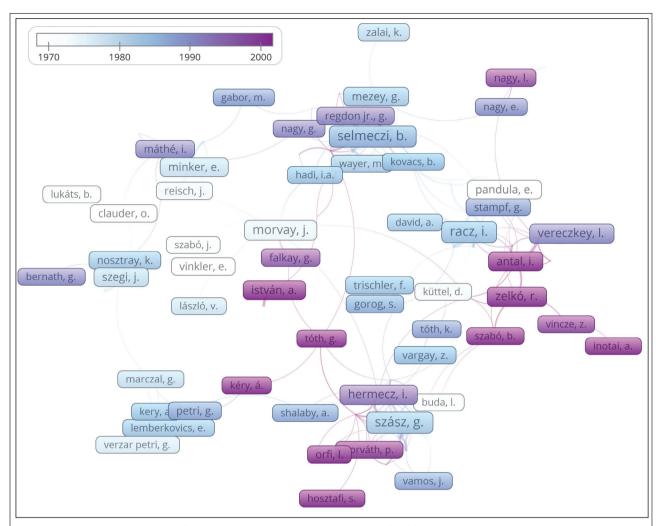
Figure 2 *Overlay visualization of co-author collaboration based on year of publication in APH between 1965-2018*

ternational impact of the papers published, the quartile ranking of APH ranged between the second (Q2; 2003) and fourth (Q4; consistently from 2011 onwards) quartile (*Table III*). International, collaborative research involving multiple partners usually enhances the impact of published articles. For this reason, the ratio of collaborative publications (defined as articles with authors from more than one country) in APH was assessed in the most recent period (2001-2018). Presented in Table IV, the highest number of articles published in collaboration was in 2007 and 2018, respectively (16.7% in both cases).

To establish the network of strong collaborators and the profile of APH in more depth, the authors and the words present in the titles and abstracts of the published documents were analyzed by VOSviewer with the aim of generating clusters and co-occurrence networks. Together with the connecting lines, the colors in *Figures 1* and *3* indicate the relationship of the authors and keywords, while in

Figures 2 and *4*, the shade of color indicates the temporal nature of relationships.

Out of 2644 authors, 186 met the threshold to become "nodes" in the generated network, while 159 could be included in the network (i.e., had at least one co-authored paper with another author qualifying to be a "node") to generate clusters of association (*Figure 1-2*). Overall, 7901 keywords were identified by VOSviewer, from which 1164 met the threshold to become "nodes" and 180 was enrolled in the generation of the co-occurrence network (*Figure 3-4*). Beginning with 1990, the most prevalent keywords were "high performance liquid chromatography", "animal tissue", "human/humans", "drug release", "bioavailability", "drug solubility", "drug manufacture", "plant extract", particle size", "molecular structure", "mass spectrometry" and "nuclear magnetic resonance", reflecting on the changing trends in pharmaceutical sciences in the period of 1980-2000.
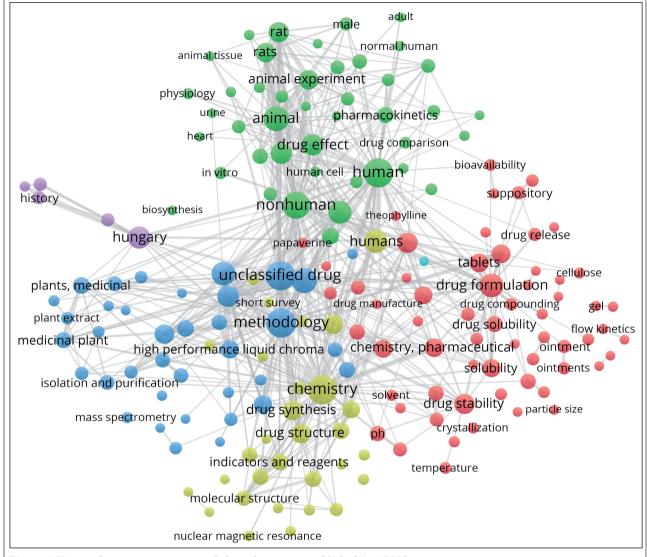
Figure 3 Keyword co-occurrence network from documents published in APH between 1965-2018

4. Discussion

The aim of this study was to assess APH using bibliometric methods in the time period between 1965-2018, in which indexing data was available from the Scopus database. From an institutional perspective, most of the papers originated from the four universities in Hungary (Budapest, Debrecen, Pécs and Szeged) where there is a Faculty of Pharmacy or the training of pharmacists takes place. In addition, the Budapest University of Technology (BME) and some industrial institutions (e.g., Gedeon Richter Ltd.) were also important contributors. Citations are generally considered an important parameter to assess the quality of papers published in any given journal, however, the absolute number of citations is not always informative (self-citations or "negative citations" that call attention to flawed

papers may distort this bibliometric indicator). The average ratio of self-citations for APH was 26.76%, which can be considered a good result, compared to other journals published in Hungary. Overall, the 20-year period between 1981-2000 was the most fruitful for this journal, based on the number of published articles and the amount of citations, while the following years between 2001 and 2018 saw a decline in the number of articles by almost 50% and the number of citations by nearly 300%, whereas the ratio of papers reporting on the research of international collaboration was variable [25-27]. The reason for this decrease may be attributable to the increasing pressure to publish in international journals with (preferably high) impact factors, because this has become a pre-requisite for the awarding of doctoral (PhD) degrees and for successful application for research grants.

Table II Publications from APH with the most amount of citations

Publication	Year	Type	Citations	Cites/year
Kiss, B.., Kárpáti, E.: *On the mechanism of action of vinpocetine* [11]	1996	Review	35	1.59
Fejes, S., Kéry, Á., Blázovics, A., Lugasi, A., Lemberkovics, É., Petri, G., Szőke, É.: *Investigation of the in vitro antioxidant effect of Petroselinum crispum (Mill.) Nym. ex A. W. Hill.* [12]	1998	Article	29	1.45
Medhin, D.G., Hadházy, P., Bakos, P., Verzár-Petri, G.: *Hypotensive effects of Lupinus termis and Coriandrum sativum in anaesthetized rats. A preliminary study* [13]	1986	Article	29	0.91
Matus, Z., Molnár, P., Szabó Gy.: *Main carotenoids in pressed seed (Cucurbitae semen) of oil-pumpkin (Cucurbita pepo convar. pepo var. styriaca)* [14]	1993	Article	26	1.04
Császár, J., Morvay, J.: *Characteristics of Schiff bases derived from salicylaldehyde and sulphonamides. Spectral and antibacterial studies* [15]	1983	Article	25	0.71
Budai, M., Szógyi, M.: *Liposomes as drug carrier systems. Preparation, classification and therapeutical advantages of liposomes* [16]	2001	Article	23	1.35
Issopoulos, P.B.: *Analytical investigations of β-lactam antibiotics in pharmaceutical preparations. IV. Sensitive colorimetric determination of five cephalosporins of the first generation* [17]	1991	Article	23	0.85
Kéry, A., Horváth, J., Nász, I., Verzár-Petri, G., Kulcsár, G., Dán, P.: *Antiviral alkaloid in Chelidonium majus L.* [18]	1987	Article	20	0.65
Lemberkovics, É.,, Kéry, Á., Marczal, G., Simándi, B., Szőke, É.: *Phytochemical evaluation of essential oils, medicinal plants and their preparations* [19]	1998	Short survey	18	0.90
El-Brashy, A.M.: *Titrimetric determination of captopril in dosage forms* [20]	1995	Article	18	0.78
Issopoulos, P.B.: *A sensitive spectrophotometric determination of acetaminophen* [21]	1992	Article	17	0.65
Sarg, T.M., Ateya, A.M., Farrag, N.M., Abbas, F.A.: *Constituents and biological activity of Bidens pilosa L. grown in Egypt* [22]	1991	Article	16	0.59
Kata, M., Schauer, M.: *Increasing the solubility characteristics of albendazole with dimethyl-β-cyclodextrin* [23]	1991	Article	16	0.59
Szántay Cs. Jr., Bihari, M., Brlik, J., Csehi, A., Kassai, A., Aranyi, A.: *Structural elucidation of two novel ergot alkaloid impurities in α-ergokryptine and bromokryptine* [24]	1994	Article	15	0.63

Table III Quartile ranking of APH between 2001-2018

Category	2001	2002	2003	2004	2005	2006	2007	2008	2009
Medicine (miscellaneous)	Q3	Q3	Q2	Q3	Q3	Q3	Q3	Q3	Q4
Pharmaceutical sciences	Q3	Q3	Q2	Q3	Q4	Q3	Q3	Q4	Q4
	2010	2011	2012	2013	2014	2015	2016	2017	2018
Medicine (miscellaneous)	Q3	Q4	Q4	Q4	Q4	Q4	Q4	Q4	Q4
Pharmaceutical sciences	Q3	Q4	Q4	Q4	Q4	Q3	Q4	Q4	Q4

Table IV Articles published in international collaboration in APH between 2001-2018

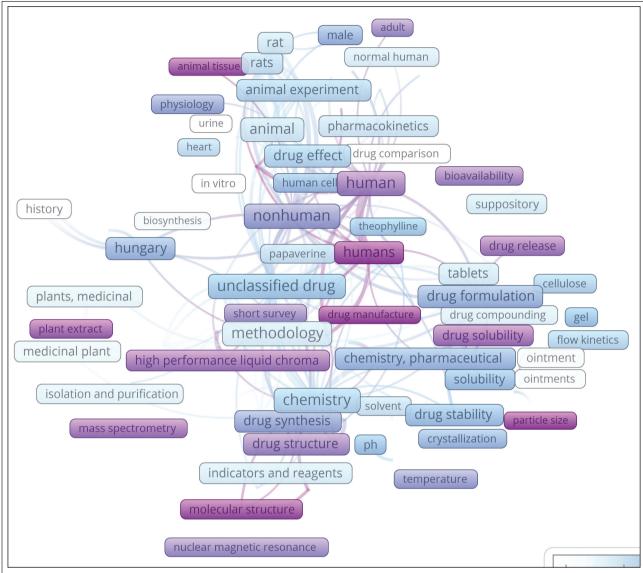|	2001	2002	2003	2004	2005	2006	2007	2008	2009
	0%	0%	6.1%	3.7%	4.4%	8.3%	16.7%	10.5%	5.0%
Precentage	2010	2011	2012	2013	2014	2015	2016	2017	2018
	0%	6.7%	0%	6.7%	5.6%	0%	15.8%	0%	16.7%

Figure 4 *Overlay visualization of keyword co-occurrence based on year of publication in APH between 1965-2018*

5. Conclusions

This study presents a qualitative and quantitative bibliometric analysis of the leading trends that occurred in the journal between 1965 and 2018, using the Scopus database for the collection of bibliographic information and specialized software for data analysis. To assess APH from a different perspective, this research also presents keyword co-occurrence and collaboration networks of the journal. *Acta Pharmaceutica Hungarica* manages to reach a very wide audience of the Hungarian scientific community of researchers interested in its content. Additionally, an evolution on the research topics covered by the journal could be observed, providing a contemporary overview of the pharmaceutical sciences. The submission of additional articles to the journal is highly encouraged to widen the reach of this journal towards international audiences.

6. Acknowledgements

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