Guidance for Young Scientists from Autobiographical Scientometrics

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Abstract: Autobiographical scientometrics studies of established scientists are rare but may contribute to guidance for young researchers. This study covered my 40-years career in Life Sciences and Biomedicine by focusing on bibliometric analysis of scientific publications and other papers and patents. Data included 811 papers published in international journals and book chapters and 6 books edited. Total citations for these publications are 44923 with author’s 98 H-index and 521 i10-index according to the Google scholar profile. Correlation was not found between citations and the number of publications per research area, journal H-index or journal impact factor (IF). Data included 36 patents in the areas of pharmaceutical, transgenesis, vaccine, formulation, probiotic and diagnostic. Three of these patents resulted in products registered and commercialized. Students are highlighted as key components of research with 36 Ph.D. thesis supervised and 6 thesis under supervision. Lessons from this study contributing to guidance for young scientists include that quality of research is the priority together with productivity but considering what, when and where to publish not only based on journal IF, H-index and quartile (Q). Inter- and multi-disciplinary international collaborations in research and co-authorship in review and method papers contribute to research quality and to advance in scientific career. Projects leading to patent applications and products improve scientific and social impact of research. Additionally, communication of results in social media is important to promote research and scientific career, and exploration of other areas such as humanities, art and music contributes to inspiration and imaginative research approaches.

Keywords: autobiography; research evaluation; citation; bibliometrics; research evaluations

1. INTRODUCTION

Scientometrics focuses on the quantitative analysis of scientific activities including publications, patents and communication. Garfield’s journal impact factor (IF) was implemented by the Institute for Scientific Information (Thomson-ISI) as an important bibliometric indicator of scientific quality [1]. Citations play a key role in IF and quartile of journal citation reports (Q1-Q4). Although differences may exist, a positive correlation between Elsevier’s Scopus CiteScore and IF has been reported [2].

The increase in open access publications is associated with a better dissemination of results, an increase in citations and academic, economic and societal impacts together with growing article processing charges (APCs) [3-5]. For example, publication pattern and scientific excellence of top-ranked scientists in biological, medical and agricultural sciences include papers published in open access journals from Elsevier, Springer, MDPI and Wiley-Blackwell (Sasvári et al., 2023). Recently established preprint platforms such as ArXiv (https://arxiv.org), Research Square (https://www.researchsquare.com) and medRxiv (https://www.medrxiv.org) among other also contribute to article visibility and dissemination.

Biographical and autobiographical papers are rare in scientific journals with highest number in Life Sciences and Biomedicine [6]. Nevertheless, these articles not only serve to highlight scientific careers, but also to provide insights on failure and success to learn from them.
Accordingly, the objective of this study is an autobiographical scientometric analysis of my 40-years career in Life Sciences and Biomedicine to provide information on assets and liabilities that may guide young scientists to get ahead in science.

2. DATA COLLECTION AND ANALYSIS

The scientometric analysis was based on author’s 40 years career summarized in the biographical sketch updated on October 5, 2023. Data was obtained from CV and bibliometric data collected from OpenAlex (https://openalex.org), CrossRef (https://www.crossref.org), Google scholar profile (http://scholar.google.com/citations?user=Cu4qOlgAAAAJ&hl), Research Gate profile (https://www.researchgate.net/profile/Jose_De_la_Fuente/?ev=hdr_xprf), ORCID ID (orcid.org/0000-0001-7383-9649), and Research.com second edition ranking of the best researchers in the field of Animal Science and Veterinary (https://research.com/scientists-rankings/animal-science-and-veterinary).

Journal H-index and IF were obtained from Scimago Journal Rank (SJR) (https://www.scimagojr.com) and Clarivate Journal Citation Reports (https://jcr.clarivate.com), respectively. Word Clouds for topics (based on publications title words) and authors (based on publications authorship) were constructed using nubedepalabras.es and based on word counts with more than 10 entries determined with the data Basic.io Word Counter (https://www.databasic.io/en_GB/wordcounter/).

2.1. Biographical Sketch

Name: José de la Fuente. Position title: Professor, Health and Biotechnology (SaBio), Instituto de Investigación en Recursos Cinegéticos (IREC), Consejo Superior de Investigaciones Científicas (CSIC), Universidad de Castilla-La Mancha (UCLM)-Junta de Comunidades de Castilla-La Mancha (JCCM), Spain. Adjunct Professor, Center for Veterinary Health Sciences (CVHS), Department of Veterinary Pathobiology, Oklahoma State University (OSU), Stillwater, OK. Education/Training: Faculty of Physics, Moscow State University, Russia and University of Havana, Cuba, Physicist, Solid-state physics, 1979-1984. Center for Biological Research and University of Havana, Cuba, Ph.D. in Biology, Genetic engineering, biotechnology and molecular biology, 1994. Positions and employment:

1984 - 1986 Center for Biological Research (Centro de Investigaciones Biológicas, CIB). Havana, Cuba.


1987 - 1991 Center for Genetic Engineering and Biotechnology (Centro de Ingeniería Genética y Biotecnología, CIGB). P.O.Box 6162. Havana 6, Cuba. Senior Scientist. Head of the Mammalian Cell Genetics Division.


2000 – 2008 Research Professor. Department of Veterinary Pathobiology, Center for Veterinary Health Sciences, Oklahoma State University. Stillwater, OK 74078-2007, U.S.A.

2002 – 2008 Visiting Professor. Instituto de Investigación en Recursos Cinegéticos IREC (CSIC-UCLM-JCCM), Ronda de Toledo s/n, 13005 Ciudad Real, Spain.


2008 - present Adjunct Professor. Department of Veterinary Pathobiology. Center for Veterinary Health Sciences. Oklahoma State University. Stillwater, OK 74078-2007, U.S.A.

Service: Serve as committee chair and member for several Master and Ph.D. students. Associate Editor for Ticks and Tick-Borne Diseases (2009-present) and Section Editor for Annals of Medicine (2020-present). Member of the Editorial Board for Experimental and Applied Acarology (2005), Biomolecules (2019), Vaccines (2019), Pathogens (2020) and. Serve as external reviewer for several journals. Councilor of The Society for Tropical Veterinary Medicine (2007-2018). Member of the Council of 100 for Vaccine. Involved in the organization of several Ticks and Tick Pathogens (TTPs) conferences. Member of Health Surveillance group, VISA VET, UCM, Spain (https://www.ucm.es/vigilanciasanitaria/). Taskforce expert on WHO CCHF project.


Principal achievements with selected supporting references:

(a) Characterization of the mechanisms involved in the regulation of gene expression for interferons alpha and beta [7, 8].
(b) Development of transgenic tilapia with higher growth speed [9].
(c) Development and clinical registry of the first recombinant erythropoietin for the treatment of acute myocardial infarction and other cardiovascular diseases [10].
(d) Development, registration and commercialization of the first vaccine for the control of cattle tick infestations [11, 12].
(e) Characterization of Anaplasma membrane proteins involved in the interaction with tick and vertebrate host cells [13, 14].
(f) Discovery and characterization of tick Subolesin, a conserved protein involved in the regulation of innate immune response and other biological processes, with protective capacity as a tick vaccine [15, 16].
(g) Characterization of host-vector-pathogen molecular interactions to understand the mechanisms involved in pathogen infection, multiplication and transmission, and vaccine development [17-23].
(h) Characterization of biomolecules/biomarkers such as alpha-Gal in infectious and allergic diseases [24-28].

3. RESULTS

3.1. Bibliometrics

Results on publications are811 papers published in international journals and book chapters (Fig. 1A), 16 papers currently under review, and 6 books edited. The number of review/opinion/editorial papers increased with time (e.g., 9/123, 7.3% during 1986-1996 vs. 93/342, 27.2% during 2013-2023). Most publications were published in scientific journals (n = 759), but some papers addressed social communications, visual arts, music and humanities (n = 52; e.g., [29-32]). Research and publications have mostly focused on the characterization of host-vector-pathogen molecular interactions and developing and implementing algorithms to translate basic biological information into the discovery of biomolecules for the diagnosis, prognosis and control of tick infestations and infectious diseases (https://youtu.be/DhbbBjQSuLYk). Accordingly, most abundant topics addressed in the publications include tick, vaccine, control, diseases, infection/infected, tick-borne, anaplasma, expression and proteins (Fig. 1B and Table 1). For example, a recent bibliometric analysis of tick vaccinology reports author’s name and publications among top ranked/cited [33].
Research has been inter- and multi-disciplinary with collaborations worldwide (Fig. 1C and Fig. 2). The number of authors per paper did not vary with time or research area with (excluding methods paper on Autophagy with 2045 authors) a tendency of more authors in original (20±26 per paper) than review (6±6 per paper) more cited papers (Table 2), but without significant differences (p = 0.06; Student’s t-test with unequal difference). Collaborators with highest coauthorship include Christian Gortázar (IREC, Spain), Katherine M. Kocan (OSU, USA), Margarita Villar (IREC, Spain), Alejandro Cabezas-Cruz (Anses, INRAE, Ecole Nationale Vétérinaire d’Alfort, UMR BIPAR, Laboratoire de Santé Animale, France), Marinela Contreras (IREC, Spain), Agustín Estrada-Peña (University of Zaragoza, Spain), and Consuelo Almazán (Universidad Autónoma de Querétaro, Mexico) among others (Fig. 1C).

Table 1. Journals with 10 or more publications

<table>
<thead>
<tr>
<th>Journal</th>
<th>Number of publications</th>
<th>Years (first – last publication)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BiotecnologíaAplicada</td>
<td>47</td>
<td>1990 - 1999</td>
</tr>
<tr>
<td>Vaccine</td>
<td>38</td>
<td>1995 - 2022</td>
</tr>
<tr>
<td>Ticks and Tick-Borne Diseases</td>
<td>33</td>
<td>2012 - 2023</td>
</tr>
<tr>
<td>Veterinary Parasitology</td>
<td>32</td>
<td>1995 - 2018</td>
</tr>
<tr>
<td>Parasites &amp; Vectors</td>
<td>25</td>
<td>2010 - 2023</td>
</tr>
<tr>
<td>Vaccines</td>
<td>23</td>
<td>2019 - 2023</td>
</tr>
<tr>
<td>Veterinary Microbiology</td>
<td>22</td>
<td>2002 - 2017</td>
</tr>
<tr>
<td>Frontiers in Cellular and Infection Microbiology</td>
<td>21</td>
<td>2013 - 2021</td>
</tr>
<tr>
<td>Advances in Modern Biotechnology</td>
<td>16</td>
<td>1992 - 1995</td>
</tr>
<tr>
<td>PLoS ONE</td>
<td>15</td>
<td>2008 - 2023</td>
</tr>
<tr>
<td>Experimental and Applied Acarology</td>
<td>13</td>
<td>1999 - 2023</td>
</tr>
<tr>
<td>Interferón y Biotecnología</td>
<td>13</td>
<td>1986 - 1989</td>
</tr>
<tr>
<td>Transboundary and Emerging Diseases</td>
<td>11</td>
<td>2010 - 2021</td>
</tr>
<tr>
<td>Theriogenology</td>
<td>10</td>
<td>1990 - 1999</td>
</tr>
</tbody>
</table>

Figure 1. Record of publications 1984-2023. (A) Yearly number of publications. (B) World Cloud for research/publication topics using paper title words. (C) World Cloud for publication authors.

According to the Google scholar profile, total citations for these publications are 44923 with author’s 98 H-index and 521 i10-index. The most cited papers include original, review and one method articles (Table 2). Of these papers, the most cited recent publications are review or method papers (Table 2). Journals with more cited publications (Table 2) are 86% in Q1 and 14% in Q2 with 2.2 – 64.5 IF and 64 – 856 H-index.
### Table 2. Publications with 200 or more citations

<table>
<thead>
<tr>
<th>Journal (reference)</th>
<th>Type</th>
<th>Authors</th>
<th>Citations</th>
<th>Year of publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autophagy [34]</td>
<td>Method</td>
<td>2045</td>
<td>3000</td>
<td>2016</td>
</tr>
<tr>
<td>Veterinary Parasitology [36]</td>
<td>Review</td>
<td>5</td>
<td>677</td>
<td>2010</td>
</tr>
<tr>
<td>Clinical Microbiology Reviews [37]</td>
<td>Review</td>
<td>4</td>
<td>549</td>
<td>2003</td>
</tr>
<tr>
<td>Animal Health Research Reviews [38]</td>
<td>Review</td>
<td>6</td>
<td>467</td>
<td>2007</td>
</tr>
<tr>
<td>Veterinary Microbiology [39]</td>
<td>Original</td>
<td>4</td>
<td>418</td>
<td>2008</td>
</tr>
<tr>
<td>Parasitology [40]</td>
<td>Review</td>
<td>4</td>
<td>405</td>
<td>2004</td>
</tr>
<tr>
<td>Frontiers in Cellular and Infection Microbiology [41]</td>
<td>Review</td>
<td>23</td>
<td>371</td>
<td>2017</td>
</tr>
<tr>
<td>Antiviral Research [42]</td>
<td>Review</td>
<td>2</td>
<td>354</td>
<td>2014</td>
</tr>
<tr>
<td>Parasite Immunology [45]</td>
<td>Review</td>
<td>7</td>
<td>284</td>
<td>2006</td>
</tr>
<tr>
<td>Journal of Clinical Microbiology [49]</td>
<td>Original</td>
<td>14</td>
<td>248</td>
<td>2005</td>
</tr>
<tr>
<td>Vaccine [52]</td>
<td>Original</td>
<td>9</td>
<td>230</td>
<td>1997</td>
</tr>
<tr>
<td>Cell [54]</td>
<td>Original</td>
<td>13</td>
<td>200</td>
<td>1990</td>
</tr>
</tbody>
</table>

Number of citations were obtained from Google scholar profile (http://scholar.google.com/citations?user=Cu4qOlgAAAAJ&hl)

Publications in the SJR top ranked journals in science included papers in Cell (original research by Kuhl et al. [7] and MacDonald et al. [54]), Nature Biotechnology (original research by Estrada et al. [10] and opinion byde la Fuente [11]), and The Lancet (letter by Gortázar et al. [22]). Of them, only an original research paper published in Cell [54] is among the most cited papers (Table 2).

![Figure 2. Scientific collaborations worldwide. Data based on scientific publications 1984-2023. Map created with mapchart.net (https://www.mapchart.net).](https://www.mapchart.net)
The analysis of citations for scientific publications showed a negative correlation between the number of citations and the number of publications (i.e., more publications with less citations; Fig. 3A), thus reflecting as expected that few publications have a higher number of citations. A positive correlation was observed between the number of citations and the year of publication with higher citations for recent papers, which likely reflects higher visibility and accessibility for these papers (Fig. 3B). The highest number of citations varied between publications in the different research areas (Figs. 3C) with more citations (Fig. 3D) in biomedicine (9.1% of papers), tick-host-pathogen interactions (14.6% of papers), vaccine (27.4% of papers), functional molecular biology (17.1% of papers), and epidemiology/ecology (22.9% of papers). However, correlation was not found between citations and the number of publications per research area (Fig. 4A), journal H-index (Fig. 4B) or journal IF (Fig. 4C).

Figure 3. Bibliometric analysis of scientific publications. (A) Correlation analysis between the number of publications (1984-2023) and the number of citations equal or higher than 10. (B) Correlation analysis between the year of publication (1987-2016) and the number of citations equal or higher than one. (C) Correlation analysis between highest number of citations for articles with 10 or more citations and the different research areas. (D) Number of publications with 4 or more citations in the different research areas. R² value for exponential correlation is shown.

Figure 4. Correlation analysis of article citations. Correlation analysis was conducted between (A) the number of publication per research area and highest number of citations, (B) the number of citations and journal H-index and (C) the number of citations and journal IF. R² value for linear correlation is shown.
Based on bibliometric analysis, author ranked No. 1 in Expertscape World Expert in Ticks (http://www.expertscape.com/ex/ticks) and Arachnida (http://www.expertscape.com/ex/arachnida). Ranked world No. 11, national (Spain) No. 1, 92 Discipline H-index (D-index), 29343 citations, 608 publications at Research.com second edition ranking of the best researchers in the field of Animal Science and Veterinary based on exclusively publications and citation data for an examine discipline collected on December 21, 2022 (https://research.com/scientists-rankings/animal-science-and-veterinary).

3.2. Patents and Products Registered and Commercialized

In addition to the role of publications in science impact, it is important to consider results that are included in granted patent applications and particularly those resulting in products registered and commercialized. During my career, 36 patents were filed in the areas of pharmaceutical, transgenesis, vaccine, formulation, probiotic and diagnostic (Figs. 5A and 5B). Of them, most patents were in the area of vaccine and filed in Cuba, Spain and USA (Fig. 5B).


Some of these patents or products were cited by other patent applications (e.g., US5296366A cited by US 7105327B1 and WO 1995/027050A1) and scientific publications (e.g., [59]).

![Figure 5](https://example.com/figure5.png)

**Figure 5.** Data of patent applications and products registered and commercialized. (A) Number of patents filed per year during 1984-2023. (B) Analysis of patent applications per career decade, subject matter, and country of application.
3.3. Mentoring of Ph.D. Students

A total of 36 Ph.D. thesis were supervised and 6 Ph.D. thesis are under supervision. The Ph.D. students play a key role in research groups and contribute to many papers included in their thesis. Additionally, students are also a key component of internationalization and scientific collaborations (Fig. 6).

For example, of the collaborators with highest coauthorship (Fig. 1C), A. Cabezas-Cruz [60], M. Contreras [61], and C. Almazán [62] were Ph.D. students with co-authored publications included in their thesis and continued collaborations as post-docs and researchers (e.g., [12, 15, 26, 28, 63, 64]). These collaborations may contribute to advancing in their careers. For example, A. Cabezas-Cruz has a 39 H-index (https://scholar.google.com/citations?user=S1rBBboAAAAJ&hl=en&oi=ao) and M. Contreras has a 23 H-index (https://scholar.google.com/citations?user=rihEH1kAAAAJ&hl=en&oi=ao).

**Figure 6. Supervised Ph.D. thesis.** Data on Ph.D. students who completed thesis under author’s supervision. Abbreviations: UCLM (Universidad de Castilla-La Mancha), UAM (Universidad Autónoma de México), UH (Universidad de La Habana), OSU, (Oklahoma State University), UTMB (University of Texas Medical Branch), AFU (Agriculture and Forestry University), CityU (City University of Hong Kong), AUTH (Aristotle University of Thessaloniki), ABU (Ahmadu Bello University), UU (Utrecht University).

4. DISCUSSION

It should be considered that although IF is an important bibliometric indicator of scientific quality [1], self-citations and editorial material covered by the Science Citation Index may contribute to journal impact [65]. Review articles are highly cited and positively affect IF [66]. The number of retracted papers published in different journals in Q1-Q4 increased since 2020 and have received citations [67]. Additionally, IF has other limitations including that it may be biased in favor of journals that have a rapid rather than a prolonged impact [68, 69] and the publication of several versions of the same manuscript [70]. Nevertheless, based on the high influence of citations on article impact, it has been proposed to use highly cited researchers with high H-index to establish a scientific elite [71].

The bibliometric analysis conducted here has shown that publications with inter- and multi-disciplinary research and collaborations worldwide are highly cited. In general, recent review/methods papers receive citations faster than original research articles. Correlation between citations and journal H-index or IF is not supported and publications in top ranked journals in science are not always highly cited. However, it has been documented that early co-authorship with top scientists positively impact on scientific careers [72]. Additionally, research in different areas facilitate collaborations and stimulate creativity, but it is important to focus on certain areas to advance scientific careers.
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Scientometric analyses have shown that quality of research output regarding quantity and quality of publications is higher in certain countries and regions with strong dominance of United States and Europe [73]. This factor is important to consider when promoting international collaborations and mentoring Ph.D. students from other regions.

Facing both global (e.g., COVID-19 pandemic) and personal (e.g., family/migratory issues) challenges as occurred in my career is important from the scientific perspective. For example, during the COVID-19 pandemic (years 2020-2023), 27 scientific articles and 9 other articles were published addressing this challenge (e.g., [22, 27, 32]). Regarding personal issues, intellectual activities including scientific research and publications in different areas were the best approach to address these challenges (e.g., [11, 29]).

A bibliometric analysis focused on patents and using largely ignored autobiographical studies showed that prolific inventors substantially contribute to technical creativity [74]. Consequently, apart from number of publications and IF, patents and related products registered and commercialized are an important component to evaluate scientific and social impact of research.

Predatory journals have been considered a global threat but are difficult to define and thus to establish strategies to avoid its use [75]. Nevertheless, we can receive multiple invitations from different journals to submit papers (in my case more that 20 emails per day) and thus trying to receive contributions from scientists who may contribute to improve journal IF.

Polymathy is defined as learning in many fields to build an encyclopedic knowledge and as attributed to T. H. Huxley (1825-1895), “Try to know something about everything and everything about something” [76]. The author discusses the decline in polymathy and concluded that “Crucially, there is often a restricted capacity for an informed, inspired, and imaginative facility that is the foundation of the greatest scientific and medical innovations for the benefit of mankind. We can conclude with Isaac Asimov (1920-1992) that “the saddest aspect of life right now is that science gathers knowledge faster than society gathers wisdom”. Therefore, communication of scientific knowledge not only through scientific publications but also in social media and other platforms is important to advance in scientific career.

The Nobel laureate in Medicine in 1960, Peter Medawar, argued that common sense and an inquiring mind are essential to advance in scientific career. In his book [77], he provides guidance on how to choose a research topic and collaborations, when and what to publish in scientific papers, and how to interact with arts and humanities. The scientific community values for excellence the international cooperation for high-quality research, and highly cited publications with a continuous publication history [5].

In a recent study, Sandström and van den Besselaar [78] showed a strong correlation between productivity determined by the number of papers and impact associated with the number of citations thus supporting that “the more papers, the more high impact papers”.

Young scientists are key components of research groups but also a challenge. We all experience how young scientists are presently pressured to produce a large quantity rather than high quality of publications to advance in their careers [79]. As cited by Lisa A. Harvey [79], they perceived need to “publish or perish”. This pressure has a negative impact and supports the need to value more quality than quantity [80]. For a Ph.D. thesis, it is not only important to establish good quality investigations and publications, but also to promote student’s collaborations, internationalization and open possibilities to continue their careers.

5. Conclusions

Lessons from this autobiographical scientometric analysis contributing to guidance for young scientists include (a) quality of research is the priority, (b) productivity is also important, and should consider what, when and where to publish, (c) journal IF, H-index and Q should be considered, but not as the only criteria for publications, (d) inter- and multi-disciplinary research with international collaborations contribute to research quality and to advance in scientific career, (e) journals bullying to receive papers should be avoided, (f) review and method papers in collaboration with other scientists contribute to citations and author’s H-index and should be published at early career stages, (g) projects that may result in patent applications and products with possibilities for registration and...
commercialization improve scientific and social impact of research, (b) communication of results in social media is important to promote research and scientific career, (i) scientific research and publications in different areas contribute to facing global and personal challenges, and (j) exploration of other areas in humanities, art and music among other contributes to inspiration and imaginative research approaches.

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AUTHORS’ BIOGRAPHY

José de la Fuente, is a Physicist and currently a Professor of Molecular Biology and Biotechnology in the SaBio group at the IREC (CSIC-UCLM-JCCM), Spain and the Oklahoma State University, USA. He is interested in innovative research approaches and his work focuses on systems biology of host-vector-pathogen molecular interactions, and translation of this basic information into development of effective vaccines and other interventions for the control of infectious diseases affecting human and animal health worldwide, ticks and tick-borne diseases, Alpha Gal Syndrome, Vaccinology and Quantum Vaccinomics.

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