Journal MVZ Cordoba
2020; 25(3):e2114.
https://doi.org/10.21897/rmvz.2114

Original

Bibliometric analysis of the scientific articles published in Veterinary Medicine and Zootechnics in Colombia 2010-2019

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Received: May 2020; Accepted: August 2020; Published: September 2020.

ABSTRACT

Objective. Analyze the scientific production in Veterinary Medicine and Animal Husbandry in Colombia in the period 2010-2019. **Materials and methods**. A retrospective cross-sectional descriptive study was carried out, through the bibliometric analysis of articles published in nine journals in the area of Veterinary Medicine and Animal Husbandry in Colombia. The information was obtained by searching the internet for each journal's website. The articles included were original articles, literature reviews, brief communications, clinical cases and editorials. **Results**. The total number of articles was 3.000; 2.250 (75%) published in Spanish, 673 (22.4%) in English and 77 (2.6%) in Portuguese. 2.282 (76.1%) were original, 224 (7.5%) literature reviews, 165 (5.5%) clinical cases, 105 (3.5%) brief communications, 204 (6.8%) editorials and 21 (0.6%) others. There were 10,296 authors; 7.109 (69%), nationals and 3.187 (31%) foreigners. Of the total Authors, 6.659 (64.7%) were men; 3.199 (31%) women and 438 (4.3%) without identification, with an average of 3.38 authors/article. Public entities contributed 77.9% of scientific production and private entities 22.1%. The areas with the highest number of publications were zootechnics, animal health, agriculture and wildlife. The top 5 of affiliations of the authors corresponded to public universities. **Conclusions**. The journal that publish in English achieve a better international positioning and in them the largest number of foreign authors publishes. The most published articles were the original ones. The top 10 of the most cited articles yielded a total of 810 citations that contribute to the internationalization of Colombia and Colombian journals.

Keywords: Information analysis; scientific press; veterinary; popularising science (*Source: EuroVoc*).

RESUMEN

Objetivo. Analizar la producción científica en Medicina Veterinaria y Zootecnia en Colombia en el período 2010-2019. **Materiales y métodos.** Se realizó un estudio descriptivo transversal **retrospectivo,** mediante el análisis bibliométrico de los artículos publicados en nueve revistas del área de la Medicina Veterinaria y Zootecnia en Colombia. La información se obtuvo mediante la búsqueda en internet de la página web de cada revista. Los artículos incluidos fueron artículos originales,

How to cite (Vancouver).
González TM, Salgado-Arroyo LC. Bibliometric analysis of the scientific articles published in Veterinary Medicine and Zootechnics in Colombia 2010-2019. Rev MVZ Cordoba. 2020; 25(3):e2114. https://doi.org/10.21897/rmvz.2114

ISSNe: 1909-0544

revisiones de literatura, comunicaciones breves, casos clínicos y editoriales. **Resultados.** El total de artículos fue 3.000; 2.250 (75%) publicados en español, 673 (22.4%) en inglés y 77 (2.6%) en portugués. 2.282 (76.1%) fueron originales, 224 (7.5%) revisiones de literatura, 165 (5.5%) casos clínicos, 105 (3.5%) comunicaciones breves, 204 (6.8%) editoriales y 21 (0.6%) otros. Hubo 10.296 autores; 7.109 (69%), nacionales y 3.187 (31%) extranjeros. Del total de autores, 6.659 (64.7%) fueron hombres; 3.199 (31%) mujeres y 438 (4.3%) sin identificación; con un promedio de 3.38 autores/artículo. Las entidades públicas aportaron el 77.9% de la producción científica y las privadas el 22.1%. Las áreas con mayor número de publicaciones fueron zootecnia, salud animal, agricultura y fauna silvestre. El top 5 de las filiaciones de los autores correspondió a universidades públicas. **Conclusiones**. Las revistas que publican en inglés consiguen un mejor posicionamiento internacional y en ellas publican el mayor número de autores extranjeros. Los artículos más publicados fueron los originales. El top 10 de los artículos más citados arrojó un total de 810 citas que contribuyen con la internacionalización de las revistas colombianas y de Colombia.

Palabras clave: Análisis de la información; publicación científica; veterinaria; divulgación científica (*Fuente: EuroVoc*).

INTRODUCTION

Scientific journals are the main means of diffusion and divulgation of the results of scientific research and ensure the quality of what is published through an evaluation process, which is adapted both to the needs of each journal, as well as to the context of scientific communities. Therefore, are responsible for the circulation of knowledge and contribution to the development of society (1). According to López-Ornelas and Cordero-Arroyo (2), all these actions are transformed into visibility for the authors and for the organizations or institutions to which they belong, which is why journals have been used as an important tool for evaluation both from researchers and from the same institutions to which they belong. Due to the boom that technological development has had and since the appearance of the internet in the 90s, new forms of diffusion and dissemination of knowledge began to develop. In this context, electronic journals, databases, repositories, virtual libraries, indexes, rankings, among other innovations, can be mentioned; which has made the evaluation more complex every day, due, among others, to new factors such as usability, downloads, institutional cooperation, impact of publications, impact of the author, collaboration index and altmetrics, for example (2).

In accordance with what has been described above, scientific journals have become one of the main objects of bibliometric studies, precisely with the intention of recognizing the work of researchers, through their scientific publications, so that the an essential aspect of bibliometrics is the citation, which implies that it is not only important to carry out good quality and relevant research, but that it must be available to the scientific community and therefore, must contribute to the development of society (3). Bibliometric has had a recent boom, but it was initially created to study the behavior of science through publications, and for its development it was considered that bibliographic information contained the necessary elements to generate an analysis with mathematical methods in a short term (4).

In recent decades, according to Arévalo, Cordón-García and Maltrás (5), scientific production has increased dramatically, as well as its indexing in different databases, referencing systems and academic networks, which has made it possible to automate and promote the use of bibliometrics. Concomitantly, indicators have been generated to measure the evolution of scientific activity, and which can be obtained using quantitative methods, based on mathematical indicators to describe its progress; thus, editors and researchers have resorted to the use of impact indicators to better understand these behaviors, which of course are variable. Using these indicators, it is possible to objectively evaluate and follow the trends of the information generated by magazines and other periodicals, which is useful for generating strategies aimed at improving editorial management to increase its impact (6,7).

On the other hand, there are frequent debates about the limitations and appropriate uses for a journal's performance indicators, which are almost as long as the history of bibliometric measurements itself. Since Scientometrics is performed using bibliometric techniques, the history of the former is inextricably linked to the latter. Like any controversy, it is difficult to separate an invention from its history, and for these reasons, an overview of some historical events that have been key to the impact factor is outlined. When Garfield proposed the concept more than 60 years ago (8), Smith comments (9), that he probably did not foresee that such impact would one day be the subject of a universal controversy still in force.

The positive association that exists between the evaluation of articles by referees and the impact, measured by the number of citations, has increased substantially in recent years (10). With the use of this information and some bibliometric tools, publishers have at their disposal additional elements to support them in making decisions with a view to improving the visibility and impact of the publications they edit. These tools are a proposal of indicators that account for the dynamics of scientific communities and the knowledge generated by them, today called responsible metrics or alternative metrics (MA), and that since their appearance have constantly evolved and, therefore, are they find different definitions according to the study carried out. Altmetrics, or alternative metrics, are a broad class of statistics that analyze the impact of research through non-traditional or conventional means of science evaluation (11,12). Sources for obtaining altmetrics data include: microblogging services or short messages (Twitter), social networking sites (Facebook), blogs (WordPress, Blogger), social bookmarking networks (Delicious), academic bookmarking platforms (CiteULike, Mendeley), peer review services (F1000, now F1000Prime), academic networks (Academia.edu) and collaboratively edited encyclopedias online (Wikipedia) (12).

In a general and understandable way for anyone, it can be said that they are a set of alternative indicators to measure the impact of publications at the article or author level, but through Web 2.0 (Facebook, Twitter, blogs, academic networks, etc.) (13).

Social networks record a large amount of information, which once properly identified, organized and analyzed, can be used to study the dissemination of scientific communication and its processes in greater depth. Jason Priem coined the term altmetrics, through a tweet, on September 29, 2010, a month later the Altmetrics manifest was created to define the evaluative study of research but analyzing the products of online academic tools (14,15).

Bibliometric studies also allow us to retrospectively examine a certain area of knowledge, evaluate the potential of the research of the institutions involved, as well as the characterization of the development of scientific disciplines and their lines of research. Likewise, it makes it possible to know the obsolescence and dispersion of scientific publications; studies that are used for the formulation of scientific and management policies, to the extent that scientific knowledge is perceived as a strategic value, especially if it is considered that they generate useful results (7,10).

In this sense, a bibliometric study carried out by Crawley (16) analyzed the citation patterns of the authors who published their articles in the American Journal of Veterinary Research (AJVR) between 2001 and 2003. Crawley (16) analyzed the 25,000 bibliographic references of these articles and grouped them by type of material, date of publication and frequency of the cited journals. The titles of the journals consulted by the authors were ranked in descending order of productivity to create a central list of journals most frequently used by veterinary medical researchers. Most of the cited articles were from magazines (88.8%), followed by books (9.8%) and, lastly, gray literature (1.4%).

In the Faculty of Veterinary Medicine and Zootechnics of the Peruvian University Cayetano Heredia (FAVEZ-UPCH), Llalla et al (17) carried out a bibliometric evaluation of the formative research in said faculty in the period 2012-2017. To develop their research, they designed an observational, descriptive, retrospective study and used bibliometric tools to systematize the information from the database of the FAVEZ-UPCH thesis bank. 195 theses were evaluated that used 6548 references, predominating consultations of scientific articles in English, followed by Spanish. Of the total references, only 29% were considered

up-to-date. Domestic animals were the most studied (43.6%), followed by wild animals (30.3%); canines (29.2%) and man (15.4%) were the most studied species. Epidemiology and public health (30.7%) and the Cayetano Heredia teaching veterinary clinic (21.0%) developed most of the theses and of them, 23.1% produced scientific articles that were published in national journals (91.2%) (17) .

The study carried out by Bravo-Vinaja and Sanz-Casado (18) characterized using bibliometric indicators, the scientific activity of Mexican institutions related to agricultural sciences. Information from articles published during the period 1983-2002 in the databases Agricola, Agris, Cab Abstracts, Science Citation Index (SCI), Social Sciences Citation Index (SSCI) and Tropag & Rural was used. The search criteria were that the affiliation of the authors included an institution based in Mexico. The records were imported into a ProCiteTM bibliographic reference manager. The total number of records was 15,736, of which 1,185 (7.53%) were obtained from Agricola, 2487 (15.74%) from Agris, 9456 from CAB Abstracts (60.09%), 168 (1.06%) from Tropag & Rural, 2 449 (15.50%) of SCI, and 10 (0.64%) of SSCI (18).

The Federal District and the State of Mexico published more than half of the articles, which shows a high concentration of research in these two states. The institutional sectors that showed the greatest research activity were public universities and research institutes or centers. The languages in which they were published were English and Spanish. The average rate of articles signed in co-authorship was 87.62%; the co-authorship rate increased from 2.47 authors per article in 1983 to 4.08 in 2002 (18).

The conceptual structure of research in Animal Science (CA) was studied by Rodríguez-Ledesma et al (19), through a longitudinal mapping analysis and performance analysis, which allows to reveal hidden issues and their conceptual evolution in 66 years (1945 -2011). The authors defined six periods: 1945–1969, 1970–1979, 1980–1989, 1990– 1999, 2000–2005, and 2006–2011. It was identified that the research in CA focused on ten areas: Animal feeding, small ruminants, animal reproduction, dairy production, meat quality, pig production, genetic and animal husbandry, poultry, animal welfare and growth factors. But it has also focused on animal welfare, genomics, management and human health. Mapping analysis provides an overview of investigating evolution over time. However, when the period is very long, shorter periods should be addressed for a better understanding of the causes of this evolution (19).

The study of specific topics can also be approached through bibliometrics, as reported by Ríos et al (20) who carried out a study on the publications made in Colombia on infectious diseases. In the study, the authors listed 2963 publications, of which 2744 (92.6%) were national and 219 (7.4%) were foreign. The publications in general addressed the following areas: parasitology 268 (32.8%), bacteriology and antimicrobial resistance 267 (32.7%), virology 210 (25.7%), mycology 46 (5.6%) and other articles related to infectious diseases 26 (3.2 %). The regional distribution (departments or regions) of the publications was: Cundinamarca 239 (29.3%), Antioquia 211 (25.8%) Valle del Cauca 60 (7.3%), Costa Caribe 52 (6.4%), Santanderes 38 (4.6%), Coffee region 31 (3.8%) and South of the country 13 (1.6%). This article was the first to analyze the publications related to infectious diseases in Colombia and it was also found that the public university supported 90% of the research in the area of infectious diseases in Colombia. These results are not only important for journals, but also for the agencies responsible for national public health.

Bibliometric studies are also important to analyze universities. Mattar et al (22), based on scientific production, international collaboration, average scientific quality, percentage of publications in journals of the first quartile SJR and radius of excellence of Colombian universities, classified them according to the Ibero-American SCImago Institutions ranking. Ranking. This study revealed that only 6.2% of Colombian institutions maintain a competitive scientific production compared to the rest of the Ibero-American universities. They also found that the Colombian universities with the highest productivity were Nacional de Colombia, Antioquia, Andes, Valle and Javeriana. In the Caribbean region they were: North, Cartagena, Córdoba, Magdalena and Sucre. These studies are important because they allow comparing Colombian higher education

institutions with others in the international arena. These studies allow a contextualized look and, this study recommends that HEIs should bet on quality and use at least the five factors proposed by SCImago. Although rankings are not mandatory, ignoring them would mean self-isolation in this highly globalized world.

Scientific journals in the area of veterinary sciences have also been the object of bibliometric studies as reported by Carreño et al (23), who analyzed the bibliometric indicators of activity of the MVZ Córdoba Magazine of 14 years (1994-2008) and De La Ossa et al (24), who conducted a bibliometric analysis of the scientific production published in the Colombian Journal of Animal Science 2009-2018. Based on the results, the aforementioned authors concluded that in order to maintain and improve the quality of the journal it was necessary to regulate and verify the topicality of the references, control self-citation, obsolescence, carry out bibliometric measurements with greater periodicity and no less important , to establish permanent surveillance on the bibliometric indexes that are generated from the journals for their analysis and orientations to which there is place.

Publications related to bibliometrics in the area of veterinary sciences in Colombia are scarce, and there are no works that study the evolution of scientific production in the area, only some related articles from the journal itself. Additionally, in the last 10 years there have been no studies on this specific matter, nor related studies to establish the state of the art, not even partial ones.

This work is a tool for the analysis of the scientific community in the area of veterinary sciences in the country. The information provided will allow to guide or propose lines of research, base decision-making related to study topics, definition of guidelines or strategies in the publication of scientific journals, rethink the language of the publication, among others. The specific objectives of this research were aimed at determining the volume of production, establishing the degree of collaboration of authors, identifying the most productive Colombian universities, scientific productions of public and private entities, languages in which the journals are published, gender of the authors, origin of the authors and identification of the most cited articles in the area.

The general objective of this study was to analyze through bibliometrics scientific production in the area of veterinary medicine and zootechnics in Colombia in the period 2010-2019 of nine journals indexed in the IBN Publindex II - 2014 call of the Ministry of Science, Technology and Innovation and in the SciELO-Colombia database.

MATERIALS AND METHODS

Type of study. A retrospective cross-sectional descriptive study was carried out, through the bibliometric analysis of the articles published in the journals of the area of Veterinary Medicine and Zootechnics in Colombia 2010 - 2019.

Inclusion criteria. Colombian journals indexed in the call IBN Publindex II - 2014 of the Ministry of Science, Technology and Innovation. This call was considered because it was the last that grouped around 520 journals before introducing the modifications to the current evaluation process. In this way, a greater number of journals for the study could be secured. Those indexed in the SciELO Colombia database were also included, since not all journals are indexed in other databases such as Web of Science or SCOPUS.

Information sources. General information was obtained from the web pages of each of the magazines. The information was collected and filtered manually, visiting the official pages of each journal, because the information reported on its main pages is not complete in databases such as SciELO, SCOPUS or Web of Science. Although it was initially considered to include alternative or altmetrics analyzes, it was not possible because all the journals in the study do not use DOI (Digital Object Identifier), which constitutes a "sine qua non" condition to carry them out.

Types of document considered for the study. The following categories were included: original articles, literature reviews, brief communications, clinical cases and editorials, which are the main types of articles that characterize scientific journals. The characteristics of the selected items are described below:

Original articles. They report on advances in veterinary science based on scientific research, they are the product of original research. They respond to a general structure that includes summary, introduction, materials and methods, results, conclusions, discussion and references. They are published in journals that have a generally double-blind peer review process. They have an extension of about 10 pages.

Literature reviews. They consist of a review and critical analysis of the published literature on a topic of science (generally current), of general interest and relevance to veterinary sciences, they are characterized by having a very extensive reference section and are longer to that of the original articles.

Brief communications. They have the same structure as the original articles, but their approximate length is 6 pages.

Clinical cases. The structure is like that of the brief communications, but after the introduction, the evaluation of the patient, the treatment approach and conclusions are continued.

Editorials. It consists of a concise expository-argumentative text, which may or may not be signed, which occupies a prominent place within the presentation of the magazine, which explains, evaluates and judges a newsworthy, novel event of special importance for society. It collects the contributions of one or more published manuscripts and generally ends with the expression of an opinion, which can provoke a debate, but new research strategies, treatments or recommendations can also be proposed if applicable.

Articles that did not fit into the categories described above were included as others (conference abstracts, reflection article not derived from research, short notes, obituaries, memoirs, etc.).

Sample and indicators. The size of the sample was obtained through the arithmetic sum of the articles published in each journal, considering the categories selected for the study, then the indicators that were considered for the collection of the information are shown.

Scientific production. It was calculated according to the number of articles indexed in each journal

Total number of authors in the period studied and per journal. It corresponded to the arithmetic sum of the total number of national and foreign authors who published in the decade studied and broken down in turn by each of the journals.

Geographical origin and type of affiliation. The origin of the authors was determined, identifying the country, the city and the classification of the entity of their affiliation (public, private or mixed).

Gender of the authors. The gender (male or female) of the authors was identified through the name with which each of them signed the article. A category was established as "undetermined gender" in those cases where the name "per se" did not allow the gender to be identified (Example: M. Durán, AJ Martínez).

Collaboration index by magazine in the decade. It corresponds to the quotient between the total number of authors and the total number of articles published by each journal in the decade studied.

Languages of publication. Identification of the publication languages of the selected journals.

Publications study area. A previous study was carried out (data not shown) in order to classify the thematic areas of publication and the following were identified that are registered in alphabetical order: Agriculture, biotechnology, infectious diseases, veterinary tests, entomology, pharmacology, wildlife, phytopathology , human health, animal health and zootechnics. The thematic areas that did not conform to those described above were entered as others.

Institutional collaboration index. List and identification of the nature and number of affiliated institutions participating in the article.

Productivity index. It was obtained by applying the logarithm of the number of original works published by each journal in the decade.

Data analysis. For storage, descriptive analysis, and statistical analysis, the Excel 365 for Windows program was used. The control of the quality of the information was carried out by means of the double entry of the data, correcting the inconsistencies by means of the meticulous consultation and confrontation with the original sources on three occasions.

RESULTS

Table 1 shows the journals selected based on the inclusion criteria of the study. The category in which these journals were found is also presented according to the results of the IBN Publindex II-2014 call. It is necessary to clarify that this is the classification before the Publindex-Minciencias database (formerly Colciencias) implemented the reform of the policies for the new measurement of Colombian academic-scientific journals and that it involved the SCImago ranking (Scimago Journals Ranking). In addition, the h5 and mean h5 indices are presented, obtained directly from the query in Google Scholar and Fi-SciELO; the latter, captured from the SciELO-Colombia website (Scientific Electronic Library Online-Colombia).

Table 2 lists the total number of articles published by each of the journals analyzed in the decade 2010-2019. A total of 3,000 articles were collected for an average of 333.3 articles per journal and a standard deviation of 10.28.

Table 1. Identification and some characteristics of the selected journals.

Long and abbreviated name of journals	ISSN	CIBN	H5	mean h5	FI SciELO
Revista Colombiana de Ciencias Pecuarias (Rev Colomb Cienc Pecu)	0120-0690	A1	9	11	0.1687
Revista Ciencia y Tecnología Agropecuaria (Cienc Tecnol Agropecuaria)	0122-8706	A2	6	9	0.1690
Revista U.D.C.A. Actualidad & Divulgación Científica (Rev UDCA Act & Div Cient)	0123-4226	A2	11	13	0.0250
Revista de Medicina Veterinaria (Rev Med Vet)	0122-9354	A2	8	12	0.1573
Revista de la Facultad de Medicina Veterinaria y de zootecnia (Rev Med Vet Zoot)	0120-2952	A2	7	12	0.1042
Revista CES Medicina Veterinaria y Zootecnia (Rev CES Med Zootec)	1900-9607	A2	7	7	0.0328
Revista Orinoquia (Orinoquia)	0121-3709	A2	7	10	0.0938
Revista Colombiana de Ciencia Animal (Rev colombiana Cienc Anim – Recia)	2027-4297	B	6	8	0.001
Revista MVZ Córdoba (Rev MVZ Córdoba)	0122-0268	A1	9	13	0.1963

CIBN: Category IBN Publindex II 2014
(*) H5 and a mean h5 https://scholar.google.es/citations?view_op=top_venues&hl=es

Table 2. Typology of articles published in selected journals.

	ORI	REV	CC	CB	ED	OTR	Totals
Rev Colomb Cienc Pecu	269	36	19	16	39	2	381
Cienc Tecnol Agropecuaria	204	10	0	1	3	1	219
Rev UDCA Act & Div Cient	454	24	14	2	21	0	515
Rev Med Vet	207	5	18	0	19	0	249
Rev Med Vet Zoot	132	8	22	0	28	0	190
Rev CES Med Zootec	125	45	33	1	15	11	230
Orinoquia	236	22	5	0	24	2	289
Rev Colombiana Cienc Anim - Recia	247	46	25	45	23	5	391
Rev MVZ Córdoba	408	28	28	40	32	0	536
Totals	**2282 (76.1%)**	**224 (7.5%)**	**165 (5.5%)**	**105 (3.5%)**	**204 (6.8%)**	**21 (0.6%)**	**3000 (100%)**

ORI=Original; REV= Literature reviews; CC= Clinical cases; CB= Brief communications ED=Editorial; OTR=Other. Source: Own elaboration.

Of the 3000 articles, 2250 (75%) were published in Spanish, 673 (22.4%) in English, and 77 (2.6%) in Portuguese. It was found that the journal that publishes the most in Spanish and Portuguese is the Revista UDCA with 469 (15.6%) articles published in Spanish and 44 (1.5%) in Portuguese. On the other hand, the journal that publishes the most in English is the Revista MVZ Córdoba with 318 (10.6%). It should be noted that this journal has published all articles in Spanish and English since 2014 and the Revista Colombiana de Ciencias Pecuarias only publishes in English, the rest, journals publish in Spanish.

Of the total of articles analyzed, 2,282 (76.1%) corresponded to originals, 224 (7.5%) to literature reviews, 165 (5.5%) to clinical cases, 105 (3.5%) to short communications, 204 (6.8%) to editorials and 21 (0.6%) were classified as other, such as obituaries, letters to the editor, conference summaries, short notes, etc.

Figure 1 shows the production index and the differences in the number of publications made in relation to the number of authors per article. An average of 3.38 authors per article was obtained. The Rev Colomb Cienc Pecu resulted with 4.09 authors per article and was the largest record; the lowest, was for Revista Orinoquia with 3.0.

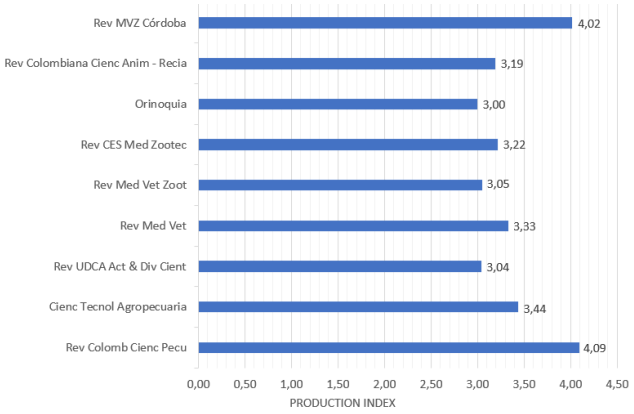

Figure 1.Collaboration index of the scientific production of the selected journals.

There is a direct and positive relationship between the authors and their productivity, with a Pearson coefficient of 0.950, results that can be seen in Figure 2.

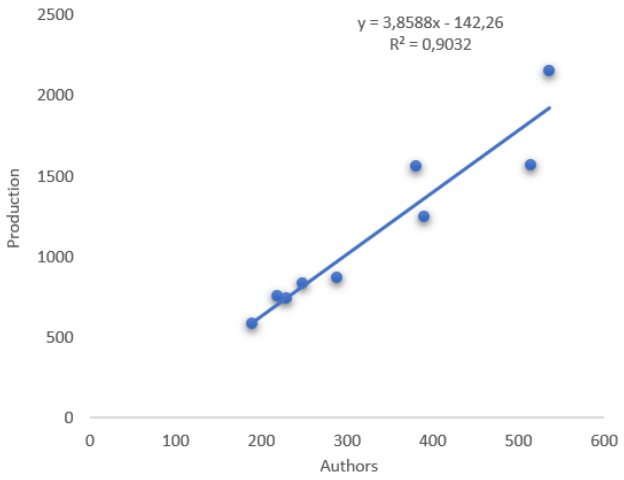

Figure 2. Pearson's coefficient of productivity.

When analyzing the author variable, a total of 10,296 authors were found, of which 7,109 (69%) were national and 3,187 (31%) were foreign (Figure 3). In general, most authors use national journals for the publication of their research. It is observed that in the Revista MVZ Córdoba, as well as in the Revista Colombiana de Ciencias Pecuarias, the number of foreign authors is greater than the Colombian authors. On the other hand, the gender of the authors was identified, and it was found that 6,659 (64.7%) were men; 3,199 (31%) women and 438 (4.3%) who could not be identified through their signature in the articles. For example, Martínez J; Suarez T. etc. (Figure 4).

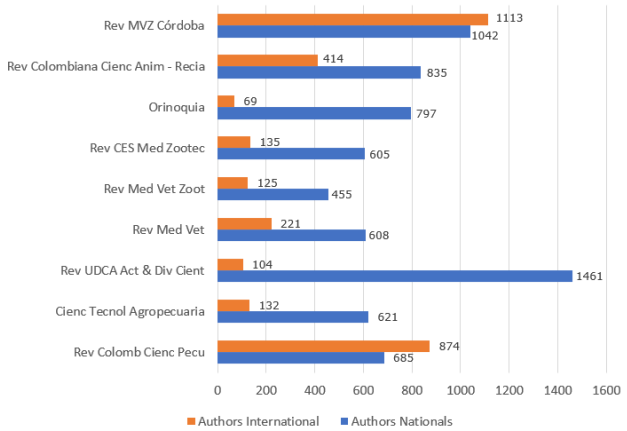

Figure 3. Origin of the authors in the selected journals.

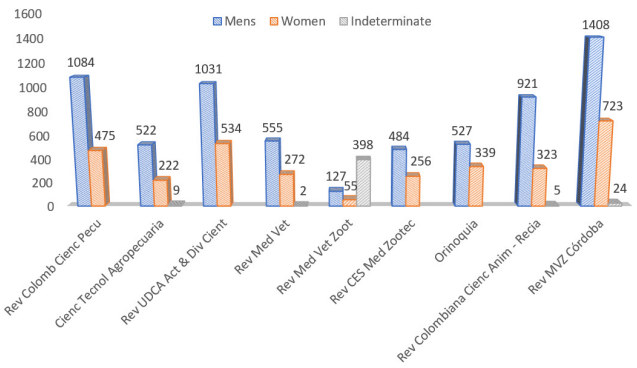

Figure 4. Gender of the authors who publish in the selected journals.

Public entities led scientific production with 77.9% vs. 22.1% of private entities. In figure 5, you can see this relationship by journal.

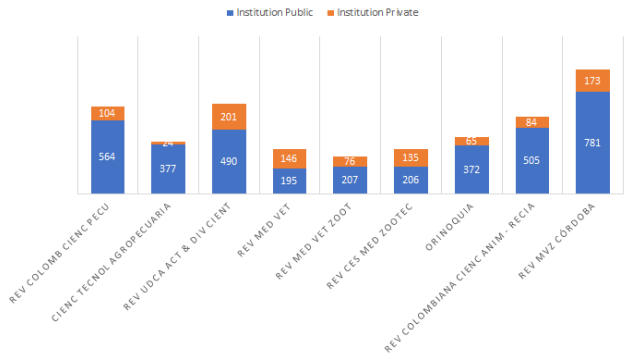

Figure 5. Participation of public and private entities in the scientific production of the selected journals.

In figure 6 the number of authors can be identified in relation to the production of articles. It should be noted that three authors are the most frequent way to co-author.

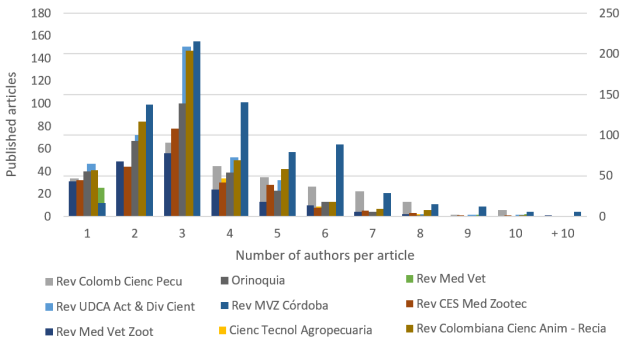

Figure 6. Number of participating authors per published article - co-authorship.

In figure 7, the geolocation of the authors worldwide of the journals under study can be observed. This graph allows inferring a certain trend of a growing acceptance of Colombian journals by the world scientific community to publish their research.

To make the selection from the list of universities, the affiliations of each author were taken for each journal and from that list, for convenience, due to the large number of records, the 20 affiliations of each of the journals with the most appearance in the registries, and then from the total of these registries, a consolidation of these was carried out, in order to select the 25 most representative affiliations within the study (Table 3).

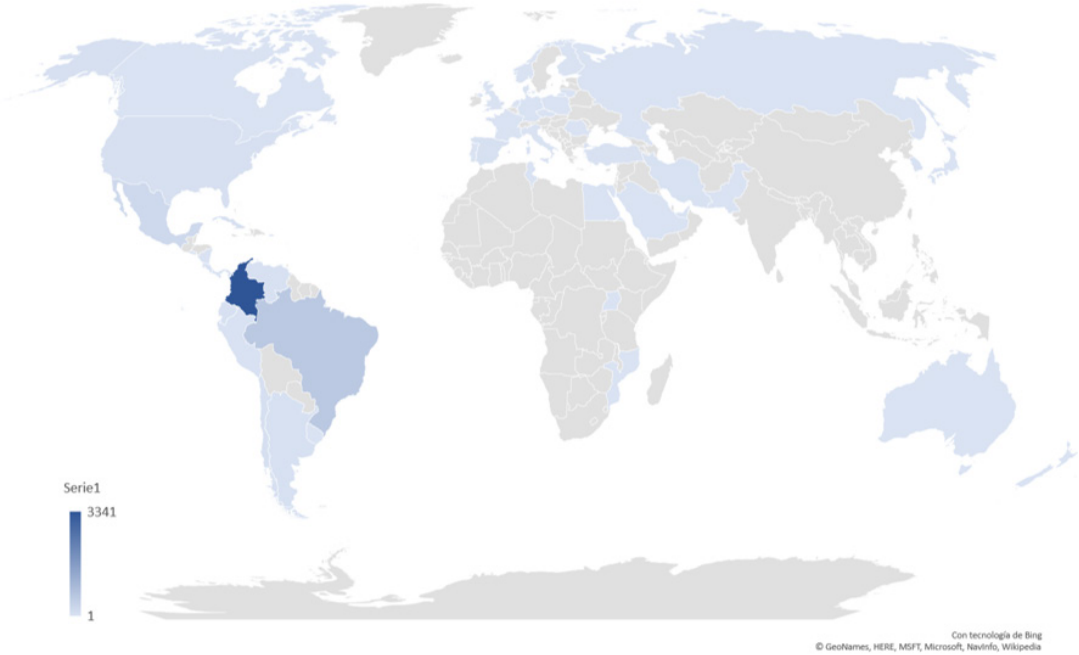

Figure 7. Geolocation of the origin of the authors of the selected journals.

Table 3. List of affiliations most cited by the authors.

Position	Universities	Records
1	Universidad Nacional de Colombia	527
2	Universidad de Antioquia	297
3	Universidad de Córdoba	288
4	Universidad de Sucre	237
5	Universidad de los Llanos	215
6	Agrosavia	191
7	Universidad de Ciencias Aplicadas y Ambientales	134
8	Universidad de La Salle	104
9	Universidad Pedagógica y Tecnológica de Colombia	86
10	Universidad Estatal Paulista	75
11	Universidad CES	71
12	Universidad de Caldas	70
13	Universidad de Nariño	70
14	Universidad del Valle	53
15	Universidad del Tolima	48
16	Universidad de Cartagena	42
17	Universidad Federal de Viçosa	33
18	Corporación Universitaria Lasallista	32
19	Pontificia Universidad Javeriana	29
20	Práctica privada	27
21	Instituto Nacional de Pesquisas da Amazônia	20
22	Universidad de la Amazonía	18
23	Universidad Cooperativa de Colombia	15
24	Universidad de Sao Paulo	15
25	Universidad Federal de Minas Gerais	15

Regarding the publication areas, zootechnics was the area where the most articles were published, followed by animal health, agriculture, followed by other areas of knowledge as shown in figure 8. On the other hand, figure 9 shows a word cloud, including some relevant subareas within the study.

An individual search per article was carried out on the academic Google platform to identify the number of citations for each of the 3000 selected records. It should be mentioned that this platform may have some inconsistencies, but it was used due to the availability of information and applied to all the journals in the study. The search was carried out in the two languages of the title of each article and after the citations in both Spanish and English were added. Table 4 shows five representative articles from each of the journals studied.

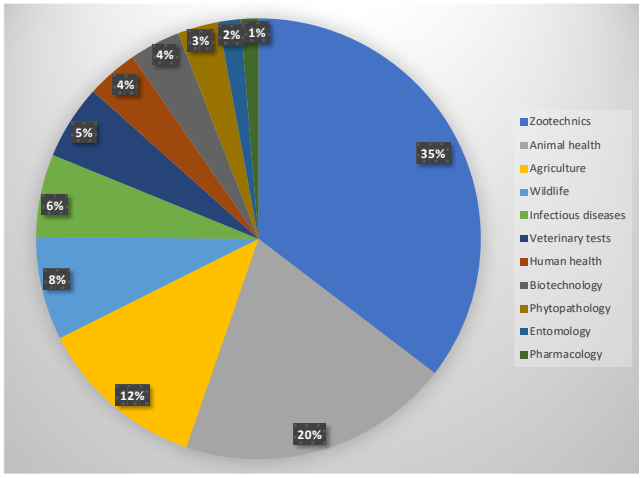

Figure 8. Most published study areas in the study journals.

Figure 9. Word cloud of the most representative areas and subareas of knowledge of the research.

Table 4. Most cited articles within the study.

Rev	Year	Article name	# date	URL
Rev Colomb Cienc Pecu	2014	Contribution of intensive silvopastoral systems to animal performance and to adaptation and mitigation of climate change	71	URL
	2011	Prevalence of mastitis in dairy herds in Eastern Antioquia¤	45	URL
	2011	Dietary acidifiers in weanling pig diets: a review	43	URL
	2011	Implicaciones de la inclusión del bienestar animal en la legislación sanitaria Colombiana	33	URL
	2011	Prevalence of mastitis in dual purpose cattle farms in Monteria (Colombia): etiology and antibacterial susceptibility	32	URL
Cienc Tecnol Agropecuaria	2010	Microorganismos que mejoran el crecimiento de las plantas y la calidad de los suelos. Revisión	80	DOI
	2011	Mecanismos de acción de las rizobacterias promotoras del crecimiento vegetal	76	DOI
	2010	Distribución de garrapatas *Rhipicephalus* (*Boophilus*) *microplus* en bovinos y fincas del Altiplano cundiboyacense (Colombia).	61	DOI
	2014	La solubilización de fosfatos como estrategia microbiana para promover el crecimiento vegetal.	60	DOI
	2010	Cuantificación e interpolación de tendencias locales de temperatura y precipitación en zonas altoandinas de Cundinamarca y Boyacá (Colombia).	37	DOI
Rev UDCA Act & Div Cient	2011	Interacción de microorganismos benéficos en plantas: Micorrizas, *Trichoderma* spp. y *Pseudomonas* spp. Una revisión.	88	URL
	2010	Evaluación *in vitro* del efecto antibacteriano de los extractos de *Bidens pilosa*, *Lantana camara*, *Schinus molle* y *Silybum marianum.*	64	URL
	2013	Reducción de la turbidez del agua usando coagulantes naturales: Una revisión.	54	URL
	2012	Potencial de reutilización del efluente de la planta de tratamiento de aguas residuales de Nátaga en cultivo de cacao (*Theobroma cacao L.).*	52	URL
	2011	Nuevo método de ayuda diagnóstica con geometría fractal para células preneoplásicas del epitelio escamoso cervical.	42	URL
Rev Med Vet	2010	Importancia de los sistemas silvopastoriles en la reducción del estrés calórico en sistemas de producción ganadera tropica.l	62	DOI
	2011	Factores asociados a mastitis en vacas de la microcuenca lechera del altiplano norte de Antioquia, Colombia	48	DOI
	2015	Seroprevalencia de *Ehrlichia canis* en perros con sospecha de infección por patógenos transmitidos por garrapatas en Medellín, 2012-2014.	27	DOI
	2011	Gestión del conocimiento: mayor producción y competitividad. Perspectivas para los sistemas de producción ovino-caprinos.	26	DOI
	2011	*Dirofilaria immitis*: una zoonosis presente en el mundo	24	DOI

Rev Med Vet Zoot	2011	Sobrepoblación canina y felina: tendencias y nuevas perspectivas.	39	URL
	2010	Cambios en la distribución y abundancia de las garrapatas y su relación con el calentamiento global.	30	URL
	2011	Evaluación del policultivo de bocachico *Prochilodusmagdalenae* y tilapia *Oreochromis niloticus* utilizando superficies fijadoras de perifiton.	30	URL
	2014	Frecuencia de pythiosis cutánea en caballos de producción en explotaciones ganaderas de córdoba, Colombia.	26	DOI
	2014	Determinación *in vitro* de la acción probiótica de *Lactobacillus plantarum* sobre *Yersinia pseudotuberculosis* aislada de *Cavia porcellus*.	26	DOI
Rev CES Med Zootec	2010	Purification, characterization and analysis of sepia melanin from commercial sepia ink (*Sepia Officinalis*).	60	URL
	2011	Nutritional characterization and ruminal degradation kinetics of some forages with potential for ruminant's supplementation in the highland tropics of Colombia.	52	URL
	2015	Monitoreo de *Ehrlichia canis*, *Anaplasma phagocytophilum,* Borrelia burgdorferi, y Dirofilaria immitis en perros de tres ciudades en Colombia.	33	URL
	2013	Evaluation of ryegrass (*Lolium* sp.) establishment in kikuyu grass (*Pennisetum clandestinum*) paddocks using zero tillage.	28	URL
	2013	Resistance of Salmonella to conventional antimicrobials for their treatment.	28	URL
Orinoquia	2010	Estructura y diversidad de bosques de galería en una sabana estacional de los Llanos Orientales colombianos (Reserva Tomo Grande, Vichada).	40	URL
	2010	La descomposición térmica de la cascarilla de arroz: Una alternativa de aprovechamiento integral.	40	URL
	2012	Perfil de los cuidadores informales de personas con enfermedades crónicas y calidad de vida, Villavicencio, Meta, 2011.	28	URL
	2012	Calidad higiénica y sanitaria de leche cruda acopiada en diferentes regiones colombianas.	27	URL
	2011	La palma de Moriche (*Mauritia flexuosa L.f.)* un ecosistema estratégico.	26	URL
Rev Colombiana Cienc Anim	2011	Hongos formadores de micorrizas arbusculares: una alternativa biológica para la sostenibilidad de los agroecosistemas de praderas en el Caribe colombiano	54	DOI
	2011	Alfabetización digital: uso de las tic's más allá de una formación instrumental y una buena infraestructura.	50	DOI
	2011	Caracterización de carne de conejo y producción de salchicha.	35	DOI
	2011	Variación estacional en escarabajos coprófagos (*coleoptera: scarabaeidae: scarabaeinae*) de la serranía de coraza, sucre (Colombia).	32	DOI
	2013	El inglés y su importancia en la investigación científica: algunas reflexiones.	31	DOI
Rev MVZ Córdoba	2011	Rickettsioses in Latin America, Caribbean, Spain and Portugal.	188	DOI
	2014	Evaluation of the physicochemical and functional properties of Colombian bee pollen.	50	DOI
	2012	Protozoan and metazoan parasites of Nile tilapia *Oreochromis niloticus* cultured in Brazil.	43	DOI
	2011	Genetic diversity of six populations of red hybrid tilapia, using microsatellites genetic markers.	40	DOI
	2011	Distribution of ectoparasites of *Canis lupus familiarisL*. (Carnivora: Canidae) from Panama.	34	DOI

Table 5 shows the total number of citations received by the five most cited articles. The journal that received the most citations was the Revista MVZ Córdoba, followed by the Revista U.D.C.A. Actualidad & Divulgación Científica, Revista Colombiana de Ciencias Pecuarias to mention those of the top 5.

Table 5. Journals with the highest citations coming only from the top 5 of the most cited articles in each of the magazines.

JOURNALS	No. of citations
Revista MVZ Córdoba	355
Revista Ciencia y Tecnología Agropecuaria	314
Revista U.D.C.A. Actualidad & Divulgación Científica	300
Revista Colombiana de Ciencias Pecuarias	224
Revista Colombiana de Ciencia Animal	202
Revista CES Medicina Veterinaria y Zootecnia	198
Revista de Medicina Veterinaria	187
Revista Orinoquia	161
Revista de la Facultad de Medicina Veterinaria y de Zootecnia	151
Total	2.092

It is observed that in total these articles received 2,092 citations, which are convenient for the same reviews and collaterally also for the country.

DISCUSSION

This research characterized the scientific production of the main journals in the area of veterinary sciences in the period 2010-2019. The results obtained allowed th

e general diagnosis of the journals involved, but it is necessary to clarify that the analysis carried out does not allow evaluating the quality of the journals or the articles published in them, but rather an analysis of the articles, using the indexes used internationally to evaluate scientific publications.

The importance of these bibliometric studies is based on the possibility of identifying the strengths and weaknesses of the publications, but always under a constructive perspective aimed at providing the necessary elements to editors that allow them to propose strategies to increase the level of competence, positioning and rigor demanded by the international scientific community of the journals they direct.

In this research, the main characteristics of scientific production between 2010 and 2019 in Colombian journals that have in common the area of Veterinary Medicine and Zootechnics were analyzed. The results made it possible to observe for the first time and in some detail what has been the research activity in this area in Colombia.

Within the type of documents considered in the study, the highest production corresponded to original research product articles. This finding allowed us to infer that a significant contribution is being made to the new knowledge in the area of veterinary sciences in Colombia. Of this contribution, it should be noted that more than 80% are made by public universities and the rest by private ones. These results coincide with the assessments made by Bravo-Vinaja and Sanz-Casado (18) who report that research activity is higher in public universities and research institutes or centers. These proportions may vary according to the subject studied, as reported by Ríos et al (20) who affirm that the public university supports 90% of the research in the area of infectology in Colombia.

Bravo-Vinaja and Sanz-Casado (18) also report that there is a high concentration of scientific production from large urban centers and particularly in two of the most developed and populated Mexican states. Something similar was also observed in Colombia by Ríos et al (20) who comment that perhaps it has some relationship with the higher labor concentration and therefore residential of the critical mass of researchers in large urban centers, or that it is in turn consistent with the size of research institutions or universities themselves.

In this context, Herrán-Páez (21), report that for the period 2003-2015 higher education institutions were the ones that contributed the highest number of articles with 41% of the total production of the country in contrast to that obtained in this study which was greater than 80%. This increase may have to do with the policies of the Ministry of Sciences, technology and innovation through the financing of research attending the calls that on the subject open annually, as well as the continuous incentives to

research teachers to produce new knowledge. The relatively high Colombian scientific production in the area of veterinary sciences is reflected with the publication of original articles (76.1%) that are the product of research. It is also important to mention the production in the other modalities considered in this study that were important and that corresponded to literature reviews, clinical cases, brief communications and editorials.

The language that predominated in the publications was Spanish (75%), followed by English (22.4%) and lastly Portuguese (2.6%). In contrast to the results of Bravo-Vinaja and Sanz-Casado (18) in their study carried out in the Federal District and in the State of Mexico, the predominant language of publication was English, followed by Spanish.

Slightly analyzing the indirect effect that the language of publication could have, it is observed that the journals that publish in English or Spanish and English, such as the Revista Colombiana de Ciencias Pecuarias and the Revista MVZ Córdoba, have a better position in international rankings; both classified in quartile 3 (Q3) of SCOPUS. Likewise, they are the magazines with the greatest international collaboration, which indisputably favors international visibility, not only of the journals "per se", but also of Colombia.

The national authors prevailed in the analyzed journals, therefore a greater effort is required to cross the border and bring the journals to an international context in order to disseminate their contents in international databases and indexes, which will probably allow interest to a greater number of foreign authors and thus contribute to overcoming regional and national barriers. For that reason we believe that one of the strategies to achieve this is to publish the publications in English, or, as in the case of the Revista MVZ Córdoba, to publish the contents in Spanish and English. These results are similar to those reported by Maz-Machado et al (25) in a study of Colombian scientific production.

The collaboration of authorship, also called the collaboration index, can be interpreted as a result of the interaction of work teams, an aspect that is currently extremely important for obtaining research resources in governmental and international entities. In these calls, interdisciplinary and inter-institutional participation is examined in detail, including between public and private institutions and territorial entities. Due to this multi and multi-participation of authors in current research, we believe that the number of authors per article will most likely tend to increase in the coming years.

In the present study, the average number of authors per article was 3.38, which could be considered low if the aforementioned concepts such as interdisciplinarity and inter-institutionalism are taken into account. This result may be influenced in some way in the inclusion of authors in public entities, since, in these, the greater the number of authors per article, the stimuli are reduced because they are divided with a greater number of interested parties, while, in private entities, this does not occur. On the other hand, Bravo-Vinaja and Sanz-Casado (18) report an average rate of articles signed in co-authorship of 87.62%, but in contrast, the co-authorship rate increased from 2.47 authors per article from 1983 to 4.08 for 2002.

In any case, we believe that the trend of collaboration should increase and, therefore, it would be advisable to enact these policies by government institutions, as well as those related to research funding. To improve co-authorship, the creation of both national and international academic networks can also be beneficial. The establishment of these strategies will most likely produce an improvement in the international view of Colombian journals by potential authors and readers.

In a study on publications related to infectious diseases in Colombia (2000-2009), Ríos et al (20) counted 2963 publications, 2744 (92.6%) were national and 219 (7.4%) were foreign. In the present study, 10,296 authors who published in veterinary sciences were counted, of them, 7,109 (69%), corresponded to national authors and 3,187 (31%) to foreigners, noting a significant increase in the participation of foreign authors in this study. Taking a general look, these results mean that the majority of Colombian journals are used by national authors for the

publication of their research. In contrast, it is observed that in the Revista MVZ Córdoba and the Revista Colombiana de Ciencias Pecuarias, they publish more foreign authors than national ones. This result, as mentioned, may be related to the publication of these two journals in the English language, which most likely attracts more readers globally.

Regarding the gender of the authors, it was found that 6,659 (64.7%) were men; 3,199 (31%) women and 438 (4.3%) could not be identified through their signature in the articles. It is observed that male participation doubles that of female, which suggests a gender imbalance in the research, as mentioned by Menéndez (26). The results of the present study are similar to those reported by Larivière et al (27), who found that women globally represent less than 30% of shared authorship, in contrast to men who reach 70%. In other words, for every article that a woman signs as the first author, there are about two papers (1.93) signed by a man. They also claim that these differences are accentuated in South America and Eastern Europe. The importance of the work of Larivière et al (27) was that it included 5.4 million research papers and literature reviews globally; including 27.3 million authors between 2008 and 2012.

In our view of the global situation, as well as the promulgation of inclusion policies at the international level, we believe that this gap in the participation of women versus men in research will tend to close, especially if the sustained increase is considered of the participation of women in all productive work fields and knowledge, and research, is the exception.

Regarding the geolocation of the consultations of the Colombian veterinary science journals, it was observed that the consultations can be considered to be carried out in the global scope, with very few or no consultations in some cases in Africa, South Asia and Greenland.

In relation to the five universities that counted the most affiliations and therefore, those with the highest production were the National University of Colombia, University of Antioquia, University of Córdoba, University of Sucre and the University of Los Llanos. These results partially agree with those obtained by Máttar et al (22) who found that the Colombian universities with the highest productivity were: Nacional de Colombia, Antioquia, Andes, Valle and Javeriana. In the Caribbean region they were: North, Cartagena, Córdoba, Magdalena and Sucre. According to these authors (22), with whom we agree, these types of studies facilitate a contextualized view of scientific production and recommend that the universities should bet on quality and use, at least, the five factors used SCImago. Although rankings are not mandatory, ignoring them would mean self-isolation, which, in our view, would not be convenient in this globalized world.

The areas of greatest publication obtained in this study were, zootechnics (35%), animal health (12%), agriculture (12%), wildlife (8%), infectious diseases (6%), veterinary tests (5%), human health (4%) and biotechnology (4%). On the other hand, Llalla et al (17) in a study carried out at the Faculty of Veterinary Medicine and Zootechnics of the Peruvian University Cayetano Heredia, found that domestic animals were the most studied (43.6%), followed by wild ones (30.3%); canines (29.2%) and man (15.4%) were the most studied species. It is necessary to clarify that the studies related to man were related to zoonotic diseases, the identification of knowledge and risky practices in the human-animal relationship, as well as the consequences of not observing the measures for the prevention of zoonoses; important information for public health professionals. In contrast, Rodríguez-Ledesma et al (19), focused their research on predetermined areas such as: Animal feeding, small ruminants, animal reproduction, dairy production, meat quality, pig production, genetic and animal husbandry, poultry, welfare animal and growth factors. But it has also focused on animal welfare, genomics, management and human health. As can be seen, these comparisons are difficult to make, since each author orients his research according to his particular interest and therefore respectable and finally acceptable.

Finally, we must focus that what increases the prestige of journals today is the citation that their articles receive, as used by international rankings with defenders and detractors of this classification and methodology.

However, bibliometric measurements may be insufficient if used in isolation as measures of research quality and importance. Tools that link peer reviews of the quality and relevance of particular research with quantitative indicators, such as citation analysis, for example, are a valuable additional tool that cannot be overlooked in research evaluation (10).

It is concluded that the journals that publish in English achieve better international positioning and a greater number of foreign authors. The type of articles that were published the most in the Colombian journals analyzed were original articles and the average number of authors per article was three. The highest scientific production corresponds to the public university (≥80%) and the articles are consulted globally, but with fewer or no consultations in Africa, South Asia and Greenland. The top 5 of the authors' affiliations corresponded to public universities and the areas most studied were zootechnics, animal health, agriculture and wildlife. The top 10 of the most cited articles yielded a total of 810 citations that contribute to the internationalization of the journals and of Colombia.

Conflict of interests

The authors of this article have no conflict of interest in the preparation, production and publication of this manuscript.

Authors' participation in the development of the manuscript

The signing authors declare that we participated in the formulation of the proposal, obtaining the information, analyzing it and writing the manuscript. The writing of this manuscript was part of the requirements to opt for the degree of Specialists in Publishing Editing, belonging to the Inter-American School of Librarianship of the University of Antioquia. Medellin Colombia.

Acknowledgements

To the University of Antioquia, to the Inter-American School of Library Science, to fellow students, to the professors and directors of the specialization, to Dr. Alejandro Uribe Tirado as tutor and to the University of Córdoba and the Faculty of Veterinary Medicine and Zootechnics.

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