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Original Article

A Bibliometric Analysis on *Dicrocoelium dendriticum*

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Abstract

Background: *Dicrocoelium dendriticum*, a worldwide zoonotic trematode, is a common parasite of ruminant animals, but humans can be the definitive host by chance. We analyzed the world situation of the parasite from the perspective of the One Health concept by analyzing the research literature published from 1931 to 2022.

Methods: Published documents related to *D. dendriticum* were searched from the Scopus database. Focusing on a visual analysis of the main research documents on *D. dendriticum*, Dimensions free web app was used to conduct co-occurrence analysis with keywords, countries, institutions, and authors. Moreover, key clustering research, affiliaitons, journals, countries, and authors were determined.

Results: The Higher Council for Scientific Research (CSIC) was the most publishing affiliation on *D. dendriticum* with 19 articles. While the Veterinary Parasitology Journal was the mostly publishing journal on *D. dendriticum* with 38 articles, the most productive country was Iran. The authors Giuseppe Cringoli and Laura Rinaldi from Università degli Studi di Napoli Federico II, Naples, Italy were the mostly publishing authors.

Conclusion: This bibliometric analysis provides an overall description of the current state of *D. dendriticum* research and the initial exploration of future research directions. Our analysis provides guidance for the development of research on *D. dendriticum*.

Introduction

Dicrocoeliosis is a foodborne zoonotic disease caused by three *Dicrocoelium* species (*D. dendriticum*, *D. hospes* and *D. chinensis*) (1). *D. dendriticum* has been reported mostly in Europe, Asia, North Africa and North America (2).

D. dendriticum is a foodborne zoonotic helminth distributed in many places, especially in ruminant breeding areas (3, 4). The WHO listed *D. dendriticum* on the list of species that should be selected by its 'Foodborne Disease Burden Epidemiology Reference Group' in 2007. *D. dendriticum*, known as the small liver fluke or the lancet fluke, is an important species mainly in veterinary sciences, medicine and health sciences (5). Especially ruminants are the most known hosts of this trematode. Apart from the definitive host, ruminants, it has a life cycle of three hosts, including two invertebrate intermediate hosts (terrestrial snails as the first intermediate host and formicide ants as the second intermediate host) (6).

Although *D. dendriticum* infection is frequently seen in domestic ruminants, reports of dicroceliasis in humans have also been reported, and this disease has been classified as a neglected parasitic disease (7, 8). This disease can cause diarrhea, flatulence, biliary obstruction, cholangitis, acute urticaria, and cirrhosis, a serious liver problem (9, 10). However, reports of pseudo-dicroceliasis have also been reported with consumption of undercooked infected liver of animals (11).

We aimed to analyze the world situation of the parasite from the perspective of the One Health concept by analyzing the research literature published from 1931 to 2022.

Methods

Data collection

Bibliometrics is a comprehensive quantitative analysis tool based on research objectives (12,13). Here, we aimed to examine *D. dendriticum* research trends using a bibliometric analysis. Thus, the main content and relationship of the key clustering research, affiliaitons, journals, countries, and authors are determined. The Elsevier's bibliometric database 'Scopus database' used to retrieve data. Our search terms were TITLE-ABS-KEY (dicrocoelium AND dendriticum) and (LIMIT-TO (DOCTYPE, "ar")). Only research articles were included in this research, while letters, reviews, editorials, and other types of articles were excluded.

Data analysis

We used Scopus database's graphs to make bibliometric analysis. Also Dimensions free web app (https://www.dimensions.ai/) used for the mappings. Scopus uses a variety of metrics to create a comparison chart for review. The Scopus Compare Sources tool provides a thumbnail for each metric type, each based on the selected chart type (Chart or Table).

Results

Analysis of documents

A total of 523 publications on *D. dendriticum* were identified. Our Scopus database search for research articles related to the *D. dendriticum* research from 1931 to 2022 yielded 473 articles. Documentation on *D. dendriticum* was stagnant from 1934 to 1947, then showed a plateau of output until 2017. Publication output increased significantly with the increasing number of publications (n = 30) from 1948 to 2017 (Fig. 1). The year of 2017 was the mostly published year with 27 articles. The number of documents published in a source is on the y-axis and the publication year is on the x-axis as shown in Fig. 1.

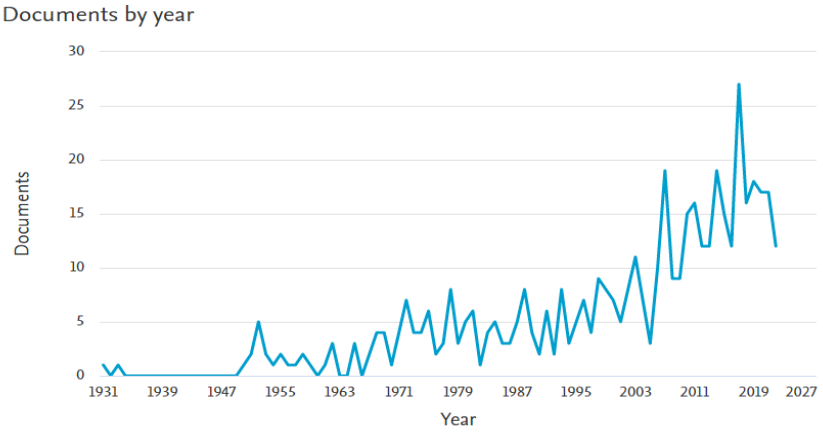

Fig. 1: Documents by year

Affiliation distribution of documents

Affiliations with more than 10 articles on *D. dendriticum* are shown in Fig. 2. The Spanish National Research Council (CSIC) (Consejo Superior de Investigaciones Científicas) was the most published affiliation on *D. dendriticum* with 19 articles

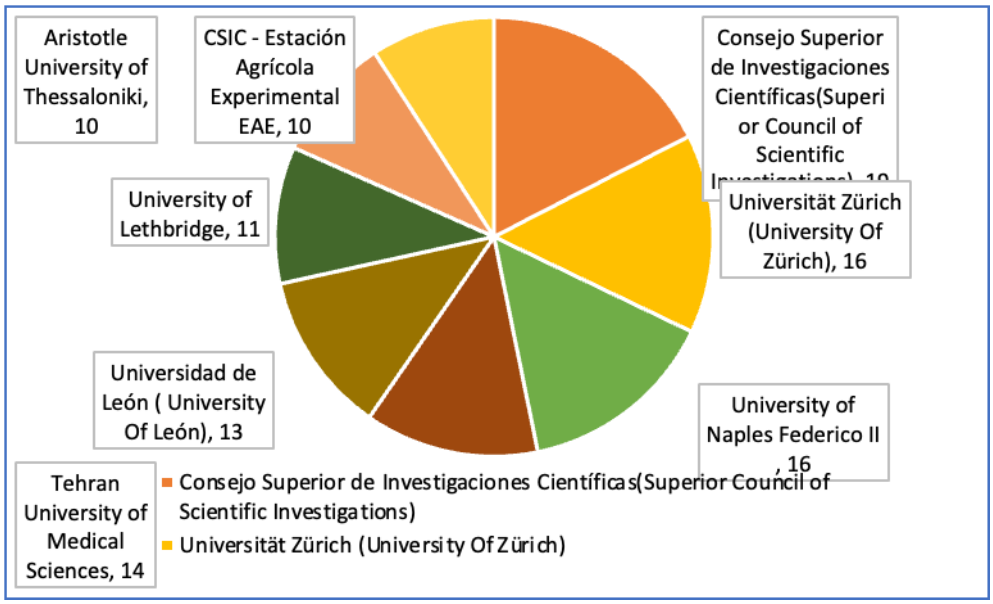

Fig. 2: Affiliations with more than 10 articles on *D. dendriticum*

Journals

One hundred fifty-three journals published at least one publication on *D. dendriticum*. Veterinary Parasitology Journal was the mostly publishing journal on *D. dendriticum* with 38 articles (Fig. 3a). When we analyze the documents of the Veterinary Parasitology Journal regarding *D. dendriticum* publications, it is seen that the journal made the most publications on this subject in 2013 (Fig. 3b)

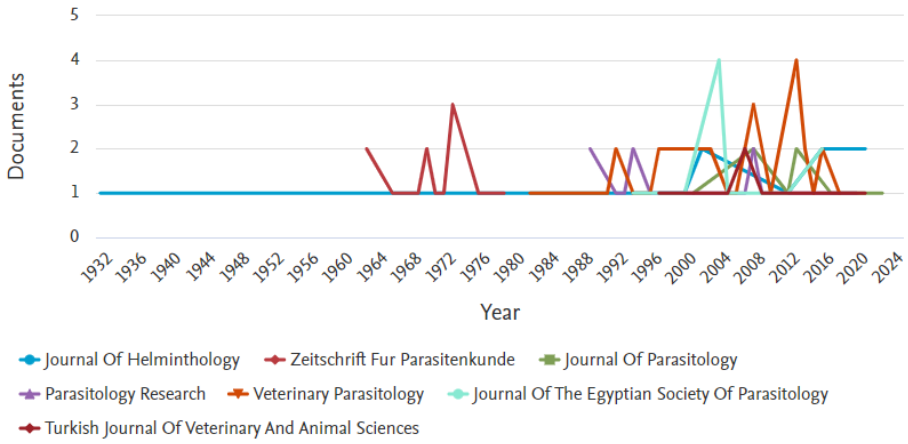

Fig. 3a: Documents per year by journals on *D. dendriticum*

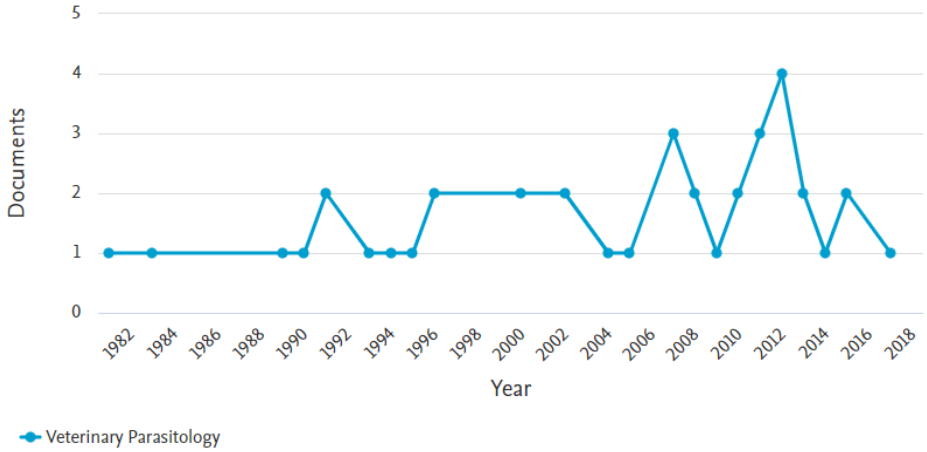

Fig. 3b: Documents of Veterinary Parasitology Journal on *D. dendriticum* per year

Countries

Sixty-three countries subscribed to *D. dendriticum* research. In the analysis of *D. dendriticum* studies by country, the countries with the highest number of publications were Iran (n = 68), Spain (n = 59), Germany (n = 36), Switzerland (n = 36), Italy (n = 35) and Turkey (n = 30) (Fig. 4).

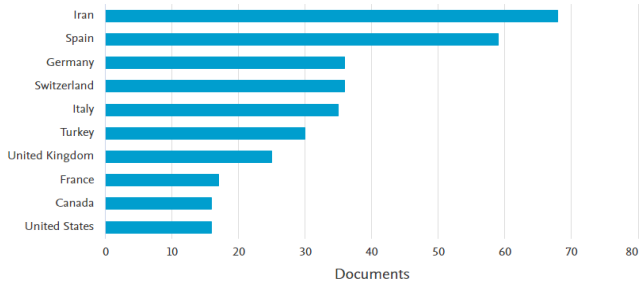

Fig. 4: Mostly publishing countries on *D. dendriticum*

Authors and citations

One hundred and sixty-one authors have published articles on *D. dendriticum*. The three most cited authors are from Italy, Germany and Italy. The top 10 most cited authors are listed in Table 1. On the other hand, the authors Giuseppe Cringoli and Laura Rinaldi from Università degli Studi di Napoli Federico II, Naples, Italy were the mostly publishing authors. We listed the top 10 most cited authors and journals published on *D. dendriticum* according to the total number of citations (Table 1). Most of the most cited journals were journals in the research field of parasitology. The average H index of the articles was 36, as shown in Fig. 5. When we analyzed the citation numbers of the top five most cited journals by year, they generally showed an increasing trend. However, the citation curves of Veterinary Parasitology and Parasitology Research were more prominent than the others (Fig. 6). Scopus' own statement says: the references are to the current year, but all documents published by the source (in Scopus) are taken into account regardless of their publication year. In the line chart, the number of citations of the source is on the y-axis and the year of publication is on the x-axis.

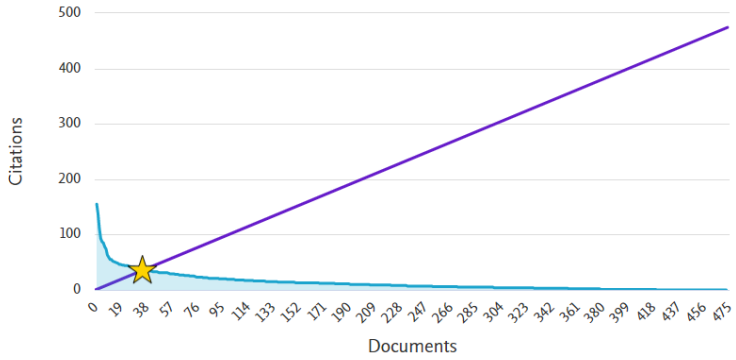

Fig. 5: Citation analysis of articles about *D. dendriticum*

Table 1: Citation analysis of authors and journals about *D. dendriticum*

Author	*Journal*	*Reference number*	*Number of citations*
Cringoli et al.	Veterinary Parasitology	23	155
Becker et al.	Zeitschrift Für Parasitenkunde Parasitology Research	24	137
Otranto et al.	Veterinary Parasitology	25	111
Rojo-Vázquez et al.	Veterinary Parasitology	26	93
Manga-González et al.	Parasitology	27	87
Bernal et al.	Journal of Proteomics	28	85
Rinaldi et al.	Veterinary Parasitology	29	78
Zali et al.	Japanese Journal of Infectious Diseases	30	74
Pérez Cordón et al.	Veterinary Parasitology	31	63
Cringoli et al.	Veterinary Parasitology	32	59

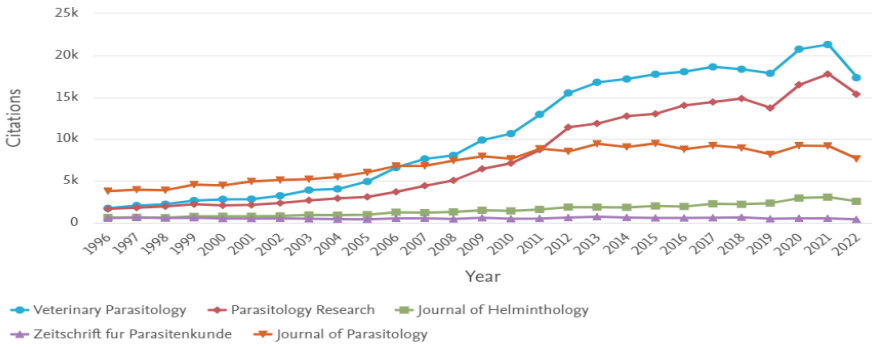

Fig. 6: Citations by years of the mostly publishing journals on *D. dendriticum*

Coauthorship analysis was performed using Dimension web free app to show the visualization network map of authors in *D. dendriticum* research. The link between authors is determined by the number of publications coauthored between them. The coauthorship analysis of authors indicates 6 clusters. These clusters are shown in Fig. 7 with different colors.

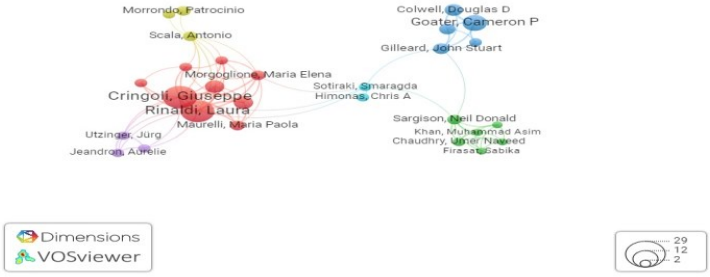

Fig. 7: VOSviewer-screenshot figure coauthorship analysis with using Dimension web free app

The citation analysis between mostly publishing authors shows 7 clusters. These clusters are shown in different colors in Fig. 8.

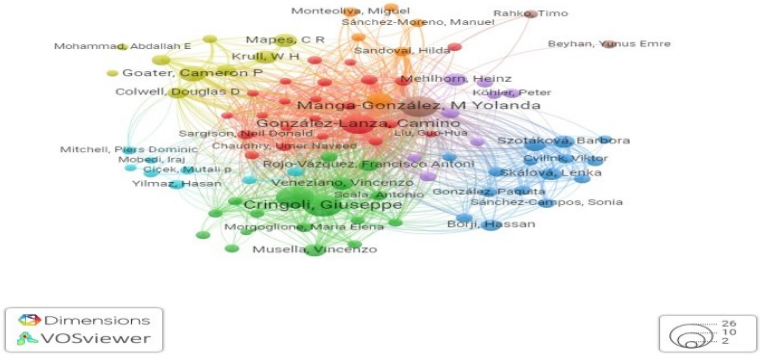

Fig. 8: VOSviewer-screenshot figure citation analysis between mostly publishing authors with using Dimension web free app

Discussion

This study identified the trend in *D. dendriticum* research all over the world by performing bibliometric analysis. Bibliometrics is a set of analysis methods used to measure literature and information in the process. This bibliometric analysis also paved the way for future *D. dendriticum* research. Using citation metrics and visualization software, we also demonstrated collaborations among researchers around the world to knowledge generation on *D. dendriticum*. We did not find any bibliometric analysis to determine the current status on *D. dendriticum*. Therefore, this analysis will greatly guide future *D. dendriticum* research.

D. dendriticum has a worldwide distribution. It is thought to be endemic in probably thirty different countries. Some countries where the parasite has been reported; in the Middle East (Iran), Europe (Spain, Germany, Switzerland, Italy, Turkey), Asia (China, Vietnam and the Indo-Malayan region), Africa (Sierra Leone, Ghana, Nigeria and), North and South America and Australia (14-15). It is a common trematode reported from almost all regions of Iran, the most productive country in terms of number of publications in this study (16-17). Spain and Germany are the current top three global leaders in the *D. dendriticum* research.

There was a cumulative increase in publications over 91 years. This increase has been observed in parasitology research all over the world. Previous publications have also reported an increase in the number of publications on parasitology over the years (18, 19). The Spanish National Research Council (CSIC) was the most published affiliation on *D. dendriticum* with 19 articles. Founded in 1939, the institution still brings science closer to society through numerous projects, events and outreach activities.

Journals are indispensable tools for announcing research to other researchers in the field all over the world. Therefore, the prestige of the journal is the performance of the published research in delivering it to other researchers in that field (20). When we examine the most cited journals on *D. dendriticum*, we see that the number of citations has changed over the years. This study accepts the view that the impact factor of article publications does not represent the quality of the articles and the number of citations can be variable (21, 22).

The authors of the most cited document, Cringoli et al., in their study published in 2004, evaluated the effect of the McMaster technique on the reliability of *D. dendriticum* egg numbers in the feces taken from naturally infected sheep and found that the flotation solution used in the study significantly affected the number of eggs per gram for *D. dendriticum* (23). The increase in the number of citations of the method used in the research over the years is also an indication that it has become widespread in diagnosis.

Coauthorship analysis, which is an indispensable element of bibliometric analysis, is used as an important indicator for research collaboration. A co-authoring network reflects collaboration between researchers and can provide opportunities for other researchers to collaborate; proper analysis of this network can offer opportunities for new collaboration outside of the existing network. Giuseppe and Cringoli were the most significant contributors to *D. dendriticum* research. Of the publications identified, 77 researchers were published worldwide on *D. dendriticum* research. Figure 7 shows that Spain is the center of an international coauthorship network and cooperates with many countries/regions. The green, blue and red coauthorship networks are mainly from European countries such as Spain, the United Kingdom, and Switzerland. The purple coauthorship networks are dominated by Germany and Turkey. Our results show that cooperation between countries has specific zonal properties. Reasons such as proximity to each other in terms of location, use of the

same language, and animal transport between countries may be the criteria determining this cooperation. Another bibliometric analysis has reached a similar conclusion (24). Increasing cooperation between authors, institutions and countries will increase the number of authors and articles published in this field, and *D. dendriticum* will be combated more effectively.

Limitations

To our knowledge, our study is the first bibliometric analysis of publications on *D. dendriticum*. In this respect, this original study has some limitations. First, the data used for the analysis is from WOS only. Therefore, it is possible that publications found on other search engines but not on Scopus have been overlooked. We plan to revisit this topic by exploring ways to combine different data sources in the literature published in the future.

Conclusion

This bibliometric analysis summarizes scientific advances in *D. dendriticum* research and displays research frontiers and trends through network visualization. These findings can provide guidance for future research and perspectives in the rapidly evolving field of health sciences. We hope that this study, which comprehensively evaluates the trends in *D. dendriticum* research, can serve as a guide in facilitating future research plans to be a guide in this research area and to advance faster in the fight.

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Conflict of Interest

The authors declare that there is no conflict of interests.

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