A Scientometric Review of Research on Intestinal Dysbiosis in Dogs (2011–2023): Trends and Insights

ABSTRACT

The aim of this study is to quantify and describe, through scientometrics, data on studies related to intestinal dysbiosis in dogs. For this purpose, articles published between 2011 and 2023 were selected using the Web of Science database. Through an active search, 137 articles were screened, of which 82 were included in this study, selected based on title and abstract evaluation. Data were collected on the number of articles published by date, number of authors, citations per author, and the countries with the highest number of publications. Data processing was conducted using R Studio software and the Bibliometrix package, ensuring greater specificity in the analyses. The results show that the year 2020 presented the highest peak of published studies, with 13 articles. It was also observed that the most cited author published 41 of the 82 selected articles, and that the United States is responsible for the largest number of publications. Through this study, it was possible to conclude that countries with greater technological resources directly impact the scientific dissemination of information on the proposed topic.

Keywords: Intestinal dysbiosis, dogs, gut microbiota, canine

1. INTRODUCTION

The gastrointestinal tract (GIT) consists of several organs, including the stomach, esophagus, small intestine, large intestine, anus, and accessory glands. These organs have specific functions in the processes of digestion, absorption, and excretion of nutrients, as well as acting as a protective barrier against bacterial translocation. The intestinal microbiota is composed of viruses, fungi, protozoa, and bacteria that play a role in maintaining the intestinal and immune barriers [1].

Intestinal dysbiosis refers to a qualitative and quantitative imbalance in the microbiota present in the intestine, reducing the proportion of bacteria that produce short-chain fatty acids (SCFAs) and other important substrates for enterocyte nutrition [2]. In other words, dysbiosis is the imbalance of intestinal microbiota colonization, where harmful bacteria outweigh beneficial bacteria [3].

In addition to impacting other physiological and nutritional functions, predisposing to an increase in pathogenic bacteria [4], it also compromises the immunological and protective functions of the canine organism, such as altering the secretion of interleukins by T lymphocytes, which deregulates inflammatory processes [5].

This imbalance can occur due to various factors, such as diet, the animal's age, gastrointestinal disorders, environmental factors, and the indiscriminate and irrational use of drugs like broad-spectrum antibiotics that are harmful to the intestinal microbiota of dogs. These antibiotics disrupt symbiotic bacteria, which can lead to gastroenteritis [3].

Primary dysbiosis (idiopathic), also known as microbiota-responsive enteropathy, is an uncommon and poorly characterized condition in dogs. It may be due to a deficiency in IgA production or failure of Toll-like receptors. The most common clinical signs are diarrhea, increased intestinal borborygmi, flatulence, belching, abdominal pain, and weight loss [6, 7].

Secondary dysbiosis can be caused by anatomical changes in the intestine, such as neoplasms, obstructions, infections, and inflammations. It commonly occurs in chronic and acute diarrhea and is associated with immunosuppression, the use of antibiotics, antacids, dietary or environmental factors. It is considered a characteristic of dogs with chronic inflammatory enteropathy [8].

Therefore, a scientometric analysis of intestinal dysbiosis in dogs is important to understand current scientific production and identify knowledge gaps, guiding future research and leading to increased research productivity, as it will provide insights into scientific trends in each location and its expertise on the subject.

This study aimed to present research, data, and scientific articles on intestinal dysbiosis in dogs, where the data was compiled and evaluated through scientometrics, with the objective of quantifying studies on intestinal dysbiosis in dogs between the years 2011 and 2023. The study sought to measure the published works regarding textual type, highlight the most frequently used keywords, identify the main authors and scientific journals that published the most on the topic, examine the publication peak related to intestinal dysbiosis in dogs during the selected years, and identify and present the countries that published the most on this subject.

2. MATERIAL AND METHODS

For the scientometric study, the Web of Science database was used. The research was conducted with the following parameters: period: from 2011 to 2023; keywords: "dysbiosis and intestine and dog"; file types: full articles. The following steps were taken.

2.1 Definition of the articles to be included in the analysis

An active search was performed in the database, where the data was filtered from 2011 to 2023 using the keywords and their derivations. Subsequently, the obtained results were inserted into a spreadsheet using Microsoft Excel®. To define the articles of interest, the title and abstract were read.

The exclusion criteria for articles in this study included the presence of duplicate materials, which were removed, as well as those whose content did not align with the objective of this research, such as studies on other species like pigs, cattle, and rodents. Articles presenting results on dysbiosis in other systems, such as the skin microbiota, the auditory canal, or the respiratory tract, were also excluded.

2.2 Collection of quantitative data from the publications

The variables used to obtain the results were: number of articles published by country, publications per year, most productive authors, most cited authors, most cited journals, and the most representative keywords.

2.3 Data analysis and processing

After data collection, the information was analyzed using R Studio software (version 4.4.1 for Windows®, Microsoft Corporation – USA), with the Bibliometrix package (version 4.3.2) for generating specific images and tables.

3. RESULTS

The search in the Web of Science database returned 479 records. After filtering for the period from 2011 to 2023 and a restrictive selection of full articles, 137 articles (100%) remained, which were exported to a Microsoft Excel® spreadsheet, and their titles and abstracts were read. As a result, a total of 82 articles (59.85%) were selected for evaluation in the R Studio program, and from this analysis, 55 articles (40.15%) were excluded. These were excluded for not focusing on intestinal dysbiosis in dogs, instead focusing on dysbiosis in other systems, accounting for 29 articles (21.17%), 9 articles (6.57%) focused on humans, and 11 articles (8.03%) addressed other species. Articles addressing comorbidities to enteropathy, such as malassezia, congestive heart failure, osteoarthritis, and atopic dermatitis, were also excluded, representing 6 articles (4.38%).

In the second stage, quantitative data was collected, provided by the database itself, such as the number of articles, most cited authors, and countries with the most publications. In the third and final stage, the data was processed using the R Studio application (version 4.2.1 for Windows®, Microsoft Corporation – USA) through Bibliometrix (version 4.3.2).

The first publication peak was observed in 2020, with a total of 13 publications, representing 15.85%. The following year, 2021, had the second-highest number of publications, with 11 publications, representing 13.41%, and in 2023, there were 19 publications, representing 23.17%, marking the highest peak among all the years studied. In 2011 and 2013, there were the fewest publications on the topic.

When observing the distribution of the number of authors, it was found that 507 authors contributed to the 82 publications. Of this total, 2 articles were published with a single author. The average number of co-authors per document was 4.568.

Upon analyzing the authors, it was identified that Suchodolski JS was the most prolific author between 2011 and 2023, contributing to 50.3% (41) of the total analyzed articles, followed by Steiner JM, who published 30.9% (25 articles) of the total. The third and fourth most prolific authors were Lidbury JA and Pilla R, each contributing 17.3% (14 articles) of the analyzed works.

The 10 journals that published the most on the topic addressed in this study were highlighted. Considering the total number of journals found (n=38) and taking into account Bradford's Law, which estimates the degree of relevance of journals in certain areas of knowledge, the journal *Journal of Veterinary Internal Medicine* was responsible for 11 publications.

When analyzing the journals using the distribution according to Bradford's Law, it is considered that: (1) *Journal of Veterinary Internal Medicine*, (2) *Frontiers in Veterinary Science*, and (3) *PLOS ONE* are references for publications of articles focusing on intestinal dysbiosis in dogs. These three journals were responsible for 27 publications, corresponding to 32.9%.

The most frequently used keywords by the authors were “dysbiosis” (n = 14), “gut microbiota” (n = 14), “microbiota” (n = 11), “dogs” (n = 10), and “inflammatory bowel disease” (n = 10). Figure 1 illustrates these keywords in a word cloud.

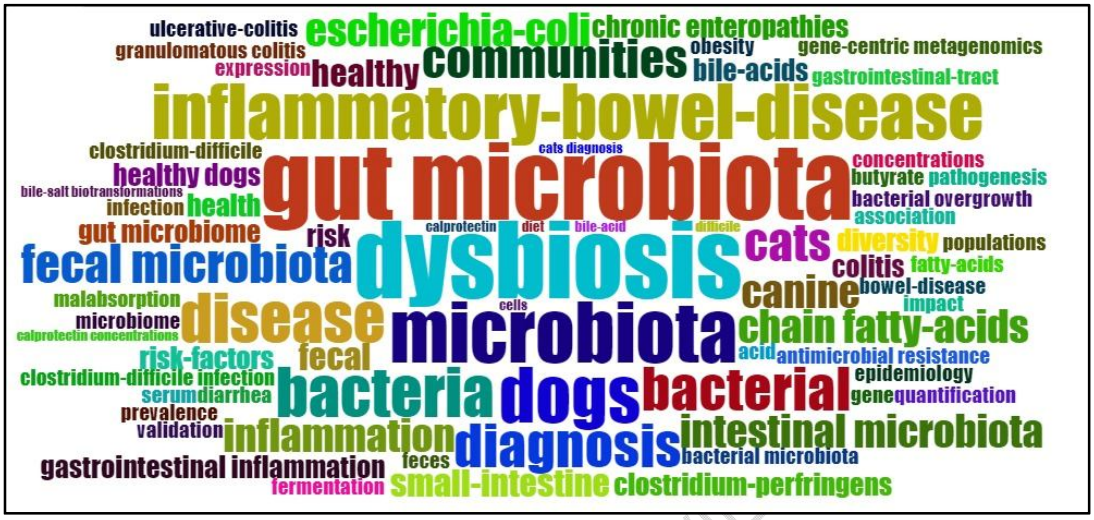

Fig. 1. Word cloud demonstrating the distribution/impact of the keywords used in the 82 articles.

Regarding the countries that contributed the most to the publications, it can be observed that the United States ranks first with 68.29% of the publications, followed by Germany in second place with 15.85%, and Italy in third place with 8.54% of the publications.

4. DISCUSSION

Scientometrics is an essential tool for analyzing scientific production, as it applies mathematical and statistical methods to quantify and evaluate patterns in the production of knowledge [9]. This study aimed to apply this methodology by analyzing articles published on intestinal dysbiosis in dogs, focusing on scientific production in recent years and identifying trends and influences on the study topic.

The results of this study reveal a significant increase in publications on intestinal dysbiosis in dogs starting in 2020, reaching its highest productivity index in 2023.This growth can be attributed to substantial technological advances in veterinary medicine, particularly in the field of genetic sequencing. Technologies such as next-generation sequencing have allowed for a deeper understanding of the genomic composition of intestinal microorganisms, enabling advances in the characterization of intestinal dysbiosis [10]. These data suggest that technological progress has played a crucial role in stimulating research on canine intestinal microbiota, corroborating the literature [10] that highlights the importance of these innovations for the advancement of veterinary medicine.

The concentration of scientific production in the hands of a few authors, such as Suchodolski JS and Steiner JM, who together accounted for 81.2% of the analyzed articles, also reflects the institutional dynamics and collaboration of academic productivity. Both authors are

affiliated with Texas A&M University, a world-renowned institution for veterinary studies [11] with a specific gastroenterology laboratory. The preponderance of these researchers can be interpreted as evidence of the centralization of knowledge in certain educational institutions, a phenomenon well documented in the scientometric literature. However, this concentration also raises questions about the diversity of perspectives and the dissemination of knowledge, aspects that should be considered in future analyses.

Furthermore, the predominance of the United States as the leading country in publications on the topic, with 68.2% of the articles, can be explained not only by the excellence of its universities but also by the size of its canine population, one of the largest in the world. This demographic factor, combined with the growing interest in animal health, especially in a country where dogs are considered an integral part of families, has driven the demand for research [12]. These findings align with previous studies indicating that the demand for animal health research is strongly correlated with the pet population.

The application of Bradford's Law, which describes the dispersion of scientific articles across different journals, was also observed in this study. It was identified that three journals—*Journal of Veterinary Internal Medicine*, *Frontiers in Veterinary Science*, and *PLOS ONE*—were responsible for 32.9% of the publications on intestinal dysbiosis in dogs. This concentration in a small number of journals reinforces the relevance of these publications as vehicles for disseminating research, in accordance with Bradford's Law, which predicts the existence of a small core of highly productive journals in each field of knowledge [13].

The results of this study confirm and expand the existing understanding of the dynamics of research on intestinal dysbiosis in dogs. The increase in publications over the past few years, driven by technological advances and scientific centralization, aligns with the literature while highlighting potential areas for future investigations, such as the diversity of voices and perspectives in research. These findings, therefore, not only corroborate current knowledge but also suggest new pathways for the evolution of research in the field.

5. CONCLUSION

The study of intestinal dysbiosis in dogs is important as this condition can affect any breed and animals of any age, potentially developing due to various causes. The more studies conducted to understand the topic, the more technologies and solutions can be developed. It is evident that countries with more technological development lead research on intestinal dysbiosis, highlighting that Brazil is not even among the top 10 countries publishing on this subject, which confirms the lack of research incentives in the country.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

REFERENCES

1. Junqueira LC,Carneiro J. Histologia Básica: texto e atlas. 13th ed. Rio de Janeiro: Guanabara Koogan, 2017.

2. Barko PC, Mcmichael MA, SwansonKS, WilliamsDA. The Gastrointestinal Microbiome: A Review. Journal of Veterinary Internal Medicine, 2018;32(1):9- 25.

3. Rodrigues MSH. Disbiose em cães. 2019.

4. Dyce KM, Sack WO, Wensing CJG. Tratado de Anatomia Veterinária. 5th ed. Rio de Janeiro: Elsevier,2019.

5. Dandrieux JRS. Inflammatory bowel disease versus chronic enteropathy in dogs: are they one and the same? Austrália: Journal of Small Animal Practice, 2016;57(11):589-599.

6. Heilmann RM, Allenspach K. Pattern-recognition receptors: signaling pathways and dysregulation in canine chronic enteropathies — brief review. Journal of VeterinaryDiagnostic Investigation, 2017;29(6):781-787.

7. Dupouy-ManescauN, MéricT, SénécatO, DrutA, ValentinS, Leal RO, Hernandez J.Updating the Classification of Chronic Inflammatory Enteropathies in Dogs. Animals, 2024;14(5):681.

8. Duarte R. Disbiose Intestinal Canina: diagnóstico e tratamento. RevistaPremieRvet, 2020;3:1-8.

9. Curty RG, Delbianco NR. As diferentes metrias dos estudos métricos da informação: evolução epistemológica, inter-relações e representações. Encontros Bibli: revista eletrônica de biblioteconomia e ciência da informação, 2020;25:1-21.

10. Suchodolski JS. Analysis of the gut microbiome in dogs and cats. Veterinary Clinical Pathology, 2022;50:6-17.

11. Xiaoyue M, Ben PM, Julie MC, Lillian AO, Crystal MG, Jordona DK, Richard BC, Christine FG, VeronicaGC, Brett WP, VictoriaO, Ryan MW.Public veterinary medicine: public health: rabies surveillance in the United States during 2018. Journal of the American Veterinary Medical Association, 2020;256(2):195-208.

12. Souza NL, Junior STA. Os desafios da alimentação natural em cães e gatos e a alternativa proposta pelos alimentos grain free. RevistaAgroveterinária do Sul de Minas, 2024;6(1):41-48.

13. Silva RC. Análise quantitativa da produção de artigos científicos para CSN3 em bovinos de aptidão leiteira. 2022.