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Unveiling Leaders and Trends in Gastroprotective Nutraceuticals: A Global Bibliometric Analysis

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***Abstract*– This study presents an exhaustive bibliometric analysis of scientific literature in the SCOPUS database. The aim is to identify leaders in publications and the best journal options for publishing. The methodology of technological surveillance was used for data collection and processing, analysis, and interpretation of results. R studio, Bibliometrix, and Scopus analysis tools were employed for image generation. The study concludes that this research area is increasingly attracting interest among researchers, with studies focusing on the use of herbs, seeds, plants, and vegetables for the production of oils and extracts evaluated for their gastroprotective activity in in-vitro and in-vivo studies. Leading contributors in research include researcher De Andrade, the country Brazil, and the journal Ethnopharmacology, all with robust bibliographic metrics. This study provides significant insights for the scientific community.**

Keywords—Gastroprotective; Bibliometric; Nutraceutical; Gastric; Ulcer.

I. INTRODUCTIÓN

Peptic ulcers represent a significant global health issue, emerging as one of the most common health problems worldwide. In the XXI century, they have become the leading disease globally. [1], Especially in countries such as Japan, Singapore, Chile, Peru, Argentina, Israel, Denmark, and the United States [2], These countries host the most common types of peptic ulcers: gastric and duodenal ulcers, which are primarily attributed to dietary habits. [1], However, a more technical analysis suggests that they form due to an imbalance between protective and aggressive factors [3].

While optimal pharmacological treatment schemes have not yet been achieved, there are treatments aimed at relieving pain, managing healing, preventing complications and recurrences. However, relapses are commonly high in number and associated with side effects. The United States, one of the countries with the highest incidence, reports around 500,000 cases annually. Brazil, known for its vast biodiversity including the Amazon—which houses 50% of global biodiversity—has a mortality rate of 3 deaths per 100,000 inhabitants from this disease, and it's noted for researching the therapeutic properties of 5,000 species. [1].

Throughout history, communities have utilized herbs and plants for gastric relief, digestive aid, and gastric protection. With the advent of modern methods and equipment, these gastroprotective effects have been quantified in individuals, provided directly by plant sources as well as some specific derived and isolated products. These therapeutic qualities have been recognized scientifically, yet this field remains underexplored and underreported in Brazil [1].

Herefore, this research aims to identify leading authors, institutions, and countries in the scientific study of these resources in terms of scientific documents.

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II. THEORETICAL FRAMEWORK

2.1. Pectic ulcers

Peptic ulcers are holes that form in the mucosa of the esophagus, stomach, or duodenum, showing evidence of wounds in the submembrane and being one of the most common health issues, with an occurrence of 500,000 cases per year in the United States alone. Generally, they are caused by conflicts between mucosal protectors and violators [5].

They are defects in the gastrointestinal mucosa that also extend into the smooth muscle tissue of the thin layer forming the digestive tract, causing discomfort in individuals primarily due to their dietary habits throughout their lives. It has become the primary disease of the XXI century, being one of the most suffered by people and for which an optimal pharmacological therapeutic scheme has not been identified, mainly aiming to calm and alleviate pain, induce healing, and prevent complications, although the relapse rate is high and has side effects [1].

Ulcers are caused by an imbalance between protective and aggressive factors. Protective factors include bicarbonate, mucus production, membrane phospholipids, and rapid cell turnover. Aggressive factors include Helicobacter pylori infection and the consumption of anti-inflammatories. This imbalance leads to the development of gastric or duodenal ulcers. Historically, duodenal ulcers were more common, but recently, their prevalence has equalized, although this varies by country and the incidence of gastric cancer. Gastric ulcers are more prevalent in countries with high rates of gastric cancer, while countries with lower rates see fewer cases of gastric ulcers [2] [6].

Studies have shown that compounds such as flavonoids and tannins possess gastroprotective effects, reducing induced wounds or ulcers in animal studies [6].

2.2. Gastroprotective

It's an effect caused by certain compounds such as alkaloids, flavonoids, saponins, tannins, and terpenoids found in some herbs, plants, or general plant sources, which contain active components and properties that provide the ability to protect the gastric mucosa from injuries [7].

Historically, communities have used herbs and plants as gastric soothers, digestive aids, and stomach protectors. With the advancement of modern methods and equipment, the gastroprotective effects of these plant sources, as well as certain derived and isolated products, have been quantified in individuals [4].

Brazil, with one of the highest levels of biodiversity in the world, presents a significant opportunity for economic value across various sectors due to the use of natural products in the food and pharmaceutical industries, and the development of new therapeutic methods. These products are considered crucial for advancing medical science research, shedding light on the action mechanisms of active principles. These principles enable the industry to develop new drugs, offer new applications, raw materials, and alternatives for treating various conditions. The study of compounds has seen considerable progress, with the presence in plant species being essential for the development of new therapeutic products. Herbal extracts, comprising a mix of ingredients to derive therapeutically valuable molecules from these sources, incorporate medicinal properties through treatment methods [6].

2.3. Technological surveillance

Technological surveillance is suggested as a strategic tool for positioning state universities, enabling them to optimize activities to define the institution's experience in academic and technological areas as a player in the national science and technology system and the entrepreneurship ecosystem. Accordingly, the academic offerings generated will be valid for the group as long as they are feasible in their life for their interests and career options. This approach is also reflected in the plans and schedules of the institutions. Countries undertake this initiative based on effective plans or programs for technology development and bridging their technological gap with leading technology nations [8].

Technological surveillance is a tool that employs ongoing analysis of both specific and general environments to enhance the competitiveness of organizations and institutions. It emphasizes the importance of standardizing surveillance processes to effectively implement models without incurring extra time and financial costs. Furthermore, it encourages the formalization of activities that might otherwise occur informally, streamlining efforts towards innovation and strategic development within institutions [9].

Technological surveillance in institutions can manifest in two ways: active and passive surveillance. Both are systems using a set of information methods and resources to capture, analyze, and systematically disseminate to the management and staff for strategic planning. Passive surveillance, more commonly applied, generates a larger volume of documents, while active surveillance is distinguished by the depth of its content. Both types must adhere to the guidelines, orientation, and standards established by the institution [8].

Technological surveillance involves capturing, analyzing, disseminating, and leveraging useful technical information for the survival and growth of organizations such as companies, institutes, and universities. It primarily focuses on detecting and identifying emerging technologies through patent databases, observing technological evolution, and the knowledge frontier in areas of interest. This contributes to assessing the innovative potential of technologies that are patentable or exploring before initiating ventures, highlighting its role as a specialized tool in innovation management [10].

It asserts that resource planning must be aligned with development exercise design, anticipate future needs, and focus on strategic objectives. With IT platform support, which aligns with the organization's mission and effectively manages planning, it becomes crucial, ensuring project viability, relevance, and value. The infrastructure of such a platform also demands appropriate financial planning, considering the benefits of proactive capital requirements management to mitigate risk and scope beyond the operational budget. Thus, a long-term vision and funding agreement allow for the real benefit of synchronizing technological surveillance efforts, ensuring sufficient resources are secured for comprehensive technical assessment and realistic lifecycle scenario planning, enhancing user preference understanding and overall human component and infrastructure management [8].

2.4. Bibliometry

It refers to a collection of information science and library science methods used to identify and examine patterns in academic publications. This allows for tracking their progression and understanding the development of research fields over time [11]. This set of methods is employed by researchers to analyze scientific and academic advancements, identifying emerging research fronts and determining the impacts of studies. Through this approach, it's possible to recognize significant trends, influential works, and key contributors within specific fields of inquiry, facilitating a deeper understanding of research dynamics and its future directions [12].

III. METODOLOGY

The methodology to be used follows the approach by Vargas and Castellanos, based on important stages for the exercise of technological surveillance. These stages are not necessarily rigid but will resemble the cycle depicted in Fig. 1. This flexible framework allows for the systematic monitoring

and analysis of technological developments, facilitating the identification of trends, innovations, and potential opportunities in the field of interest [13].

The technological surveillance cycle will serve as a guideline for conducting this exercise in the sector of gastroprotective nutraceuticals, as defined for bibliometric analysis. This approach will enable a structured examination of the current state and advancements within the field, ensuring a comprehensive understanding of its dynamics, key players, and future directions [13].

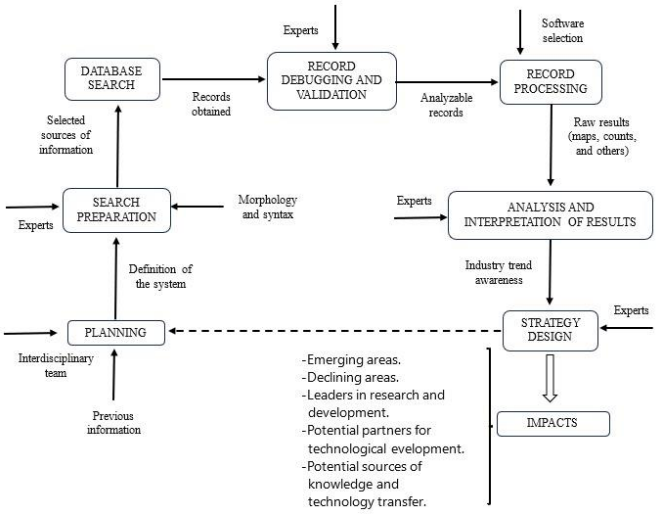

Fig. 1. The technological surveillance [13].

Given the context and following the cycle illustrated in Figure No. 1, the methodology's implementation across its stages is described. This ranges from planning and preparing the search to conducting the search, refining the records, and processing the records. It's noted that the results and analysis will be detailed in the subsequent sections of the research, providing a structured approach to exploring the sector of gastroprotective nutraceuticals through bibliometric analysis.

3.1. Planning

Information was collected on foods and natural sources with a gastroprotective effect with the aim of identifying the main producers of scientific documents and research trends

3.2. Preparing to search

At this stage, the Scopus scientific database was identified as the source for document analysis due to its wide variety of scientific publications with high impact on the community and relevance to the topic of interest [14]. The Carrot2 tool was used to delve into the topic of interest and identify key words that would aid in the document search. This open-source search engine organizes searches into categories using an algorithm that relates the jargon or technical language for each group, facilitating a more focused and effective search process for relevant scientific literature [15] [16]. A tree map was generated as shown in Figure 2 using the search equation, illustrating the categorization and relationships of keywords identified through Carrot2. This visualization aids in understanding the thematic distribution and clustering of terms related to the gastroprotective effects of foods and natural sources within the scientific literature “Gastrotective and (food or plant or oil)”.

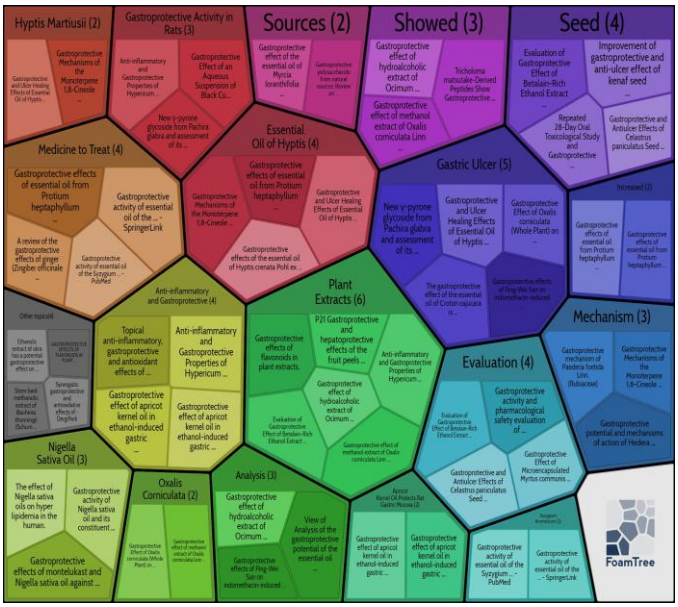

Fig. 2. Tree map

To conclude the search preparation, the identified keywords were evaluated using document review and the CARROT2 tool in terms of their importance, relevance, and pertinence for conducting the search in the Scopus database. The keywords identified are listed in Table 1, which is shown below

TABLE 1
KEYWORDS

Keyword	Descriptión
Gastroprotective	The ability to protect the gastric mucosa [7]
Antiulcer	Protective effect against gastric ulcer or injury [17]
Ulcer healing	Gastric ulcer healing methods globally rely on visual checks and measuring ulcer sizes in lab animals [18].
Stomach protective	Stomach Protection activity [19]
Antigastritic	Indicates a gastroprotective effect [20]
Gastric protection	Protection of the stomach from a hostile environment or condition [21]
Food	They can be grouped according to their level of processing [22].
Oil	They come from natural sources and may provide gastroprotective effects [23]
Plant	Potential source of drugs for the treatment of various diseases [24]
Herb	Chamomile and star anise, with potential anti-inflammatory and antimotility effects, may aid in treating gastrointestinal issues [25].
Vegetable	They're nutrient-rich foods, often analyzed for their composition [26].
Nutraceutical	They are functional foods recognized for their health

	benefits [27].
Phytochemical	Phytochemicals or natural products of plant origin have been a potential source of drug candidates for human diseases for many years [28]
Extract	Derived from natural sources, it offers health benefits like ulcer prevention [29]
Grain	Natural source with low humidity that may have activity against ulcers [30].
Seed	Possible source of extract and oils with posible gastroprotective effects [31]
Medicinal plant	Associated with medicinal food plants play a vital role in fighting and safeguarding health [32]

3.3. Database search

The Scopus database was searched using the keywords described above and advanced search strategies.

3.4. Debugging and validation of records

Base don the searches perfomed in the Scopus database, the results were reviewed and it was verified that these documents are focused on the research topic, validating the general equation and search strategy as shown in table 2 below:

TABLE 2
SEARCH STRATEGY

Search field	Descriptión
Article title	Gastroprotect* OR antiulcer OR “ulcer healing” OR “stomach protective” OR antigastritic OR “gastric protection”
Abstract	Food OR oil OR plant OR herb OR vegetable OR nutraceutic* OR phytochemical OR extract* OR grain OR seed OR “medicinal plant”
Year	2014 to 2023
Document type	Article, book chapter y conference paper
Subject area	Excluded: Physics and astronomy, Computer science, neuroscience, mathematics, Earth and planetary sciences, dentistry, social science, energy, psychology, economics, econometrícs and finance.

The search was conducted on January 24, 2024 and 605 documents strongly related to the topic of interest were obtanied.

3.5. Processing the records

The records obtained from Scopus were processed with Bibliometrix software for further analysis.

IV. Results

4.1. Quantity indicator

Quantity indicators were used to identify the authors, journals, and countries with the highest number of publications in the researched sector, providing a clear overview of the leading contributors and their impact on the field of study.

4.1.1. Number of documents by authors

The author with the most publications on the researched topic is De Andrade, S. F., who has 21 publications, totaling 129 documents with an H-index of 30. His work primarily spans pharmacology, toxicology, and pharmacy, followed by medicine, and agricultural and biological sciences. His most cited article from 2015, with 50 citations, highlights the healing activity of gastric ulcers using Maytenus robusta through in vivo and in vitro studies, suggesting its potential as a source for developing therapeutic formulas for gastric ulcer treatments. [33]. However, regarding more recent articles, in 2018, he published one that has accumulated 23 citations, analyzing the chemical composition and gastroprotective properties of Eugenia involucrata through its extracts, achieving an effective treatment at a dose of 125 mg/kg. Additionally, the study also evaluated antinociceptive effects. [34]. In 2020, De Andrade, S. F. gained 24 citations for his study on the antioxidant properties in the gastroprotective and gastric healing activity of Brazilian green propolis and the healing efficacy of its main compound, Artepillin-C. The study concluded that this source has gastroprotective healing properties through in vivo study, highlighting the potential of Brazilian green propolis in the development of treatments for gastric issues. [35]. In this way, most of their work studies the gastroprotective activity of different plant source by means of in vivo and in vitro studies.

Thaise Boeing, ranking second in publication quantity, has authored 17 documents on the investigated topic, with a total of 72 documents and an H-Index of 20. Her research primarily focuses on pharmacology, toxicology, and pharmacy, as well as medicine, immunology, and microbiology. Affiliated mainly with the Universidade do Vale do Itajaí, her most significant work includes collaboration with De Andrade, notably a 2015 publication. A notable 2021 study by Boeing evaluates the gastroprotective effect of hydroalcoholic extract from red propolis in Northeast Brazil, supporting the traditional use of this plant source for gastric disorders [36]. Their papers show a dedication to the ecaluaction of plant sources as gastroprotectans and the application of in vitro and in vivo analysis for the determination of these.

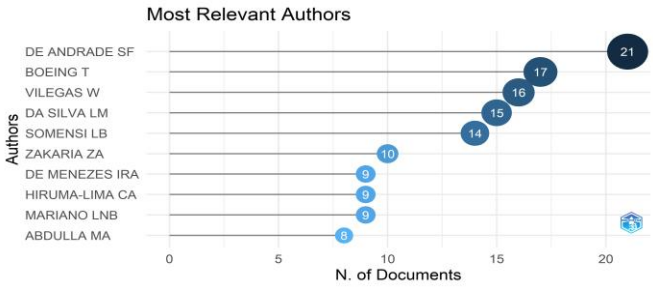

Fig 3. Documents by author

4.1.2. Number of documents per journal

The journal with the highest number os published papers is the Journal os Ethnophamacology with 53 papers in the topic investigated, wich specializes in pharmacology, toxicology and phamacy [37] a promotes the generation of information and scientific knowledge on the use of plant sources, microorganisms an minerals with their biological and

pharmacological effects. For the ares of pharmacology is in the 2nd quartile and until 2020 and a average of 6 citations per document according to the scimagojr.com portal [38], which gives us good reference, the document with the highest number of citations for this journal is on the gastroprotective activity of *Maytenus robusta* in 2015, where they showed that the hydroalcoholic extract from this plant source, if it has gastroprotective effects [33]. Another significant study from 2021 explored the gastroprotective activity of kaempferol glycosides from *Malvaviscus arboreus*. This research involved extracting these compounds and dosing rats that had been previously induced with gastric ulcers. The study concluded that the extract and its components possess gastroprotective properties, highlighting the potential therapeutic value of Malvaviscus arboreus in treating gastric ulcers [39]. Another significant article from 2022, receiving 10 citations, investigates the gastroprotective effect of Eugenol in rats. The study demonstrates that Eugenol exhibits considerable gastroprotective effects at low doses and is attributed properties for regulating inflammation [40].

The journal with the second largest number of papers is Evidence-based Complementary and Alternative Medicine, which has 21 papers related to the topic under investigation, and is framed in the área of medicine [41], where it promotes and encourages research on complementary and alternative medicine as well as traditional healing systems, is ranked in quartile 2, with an average number of citations around 3 per document [42]. The most significant article in this field from 2017 investigated the anti-ulcerous and cytotoxic potential of *Calotropis procera*, traditionally used to treat various diseases. The study concluded that it exhibits potent anti-ulcerous activity, making it a promising candidate for drug development. [43]. Another relevant paper has 12 citations since 2021, and studies the gastroprotective effect of myricetin on ethanol-induced gastric lesions in rats [44].

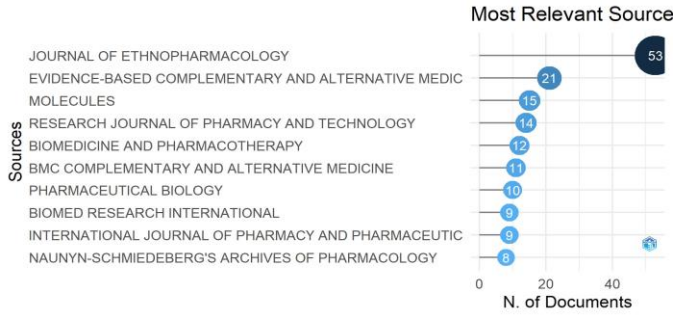

Fig 4. Documents by journals

4.1.3. Number of documents per country

Brazil leads in the production of articles on gastroprotective nutraceuticals with 131 documents, among which two from 2015 stand out due to the citations they received. These studies investigate the gastroprotective mechanisms of the monoterpene 1,8-cineole (eucalyptol), demonstrating its role as a healing agent for ulcers [45], and in the other they also evaluate the gastroprotective effect of another monoterpene, but this time alpha-pinene, in wich they also show that this compound has anti-ulcerogenic activity [46]. In recent years it has 8 citactions in the study of the gastroprotective effect of *Agaricus blazei*, which was demonstrated by the reduction of some histopathological parameters and the reduction of mastocytosis in the stomachs of rodents [47].

India ranks second with 122 documents, including two notable articles from 2018 that received 119 and 68 citations, respectively. The first article provides an update on potential gastroprotective mechanisms and strategies against cisplatin induction, highlighting phytochemicals used to counteract gastric dysfunction and evidencing protection against intestinal damage in literature [48]. The second article demonstrates the gastroprotective potential of the methanolic extract from *Cordia dichotoma* on gastric lesions induced in rats, showing reduced gastric damage. This validates the gastroprotective potential of this plant source [49].

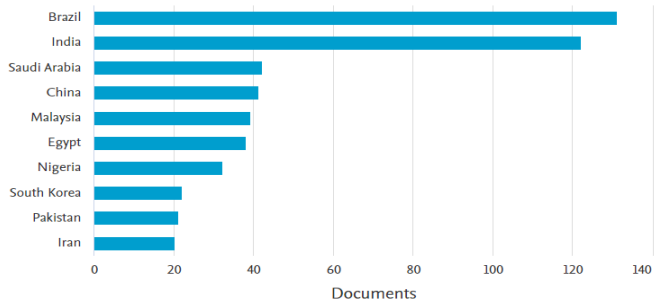

Fig 5. Documents by country

4.2. Quality indicators

These are base don the number of citations because they are recognized as more influential and deserve the main attention in their field [50].

4.2.1. Impact of authors

De Andrade leads in impact with an H-index of 12 in the field of gastroprotectors, followed by Boeing and Da Silva, both with an H-index of 10. These results align with the leadership of authors based on the quantity of articles. Citations for their work vary, sometimes being abundant and other times sparse, reflecting the fluctuating recognition and influence of their research within the academic community [51]. Given that the H-index represents the number of articles that have the same number of citations for the author and is one of the best known indexes, the H-index is the number of articles that have the same number of citations for the author [52].

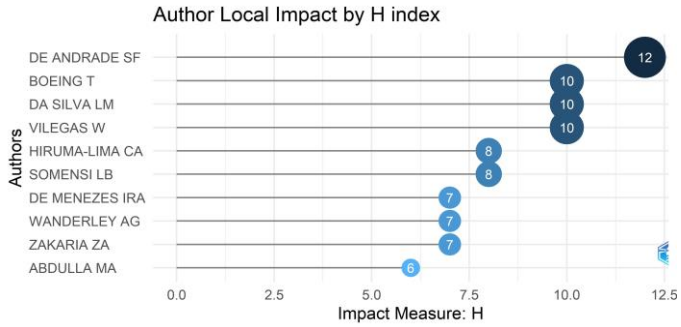

Fig 6. Impact of authors

4.2.2. Impact of journals

The Journal of Ethnopharmacology leads with an H-index of 20 in gastroprotector research, excelling in both article quantity and impact, followed by Evidence-based Complementary and Alternative Medicine and Biomedicine and Pharmacotherapy, each with an H-index of 10. This citation data is highly relevant academically, aiding the scientific community in bridging current findings with future directions and informing funding decisions [50].

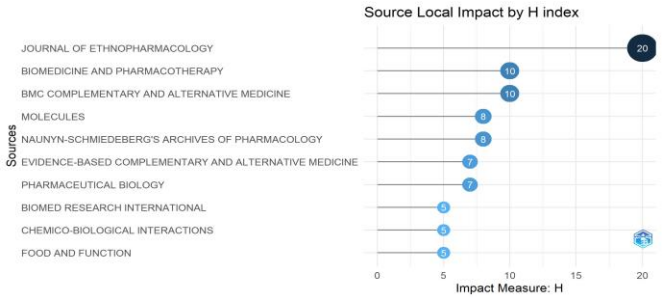

Fig 7. Impact by journal

4.2.3. Impact of country

Brazil leads significantly in citations within gastroprotective research, accumulating 1710 citations in total, followed closely by China and India with 522 and 502 citations, respectively. This trend is likely to continue given the volume and quality of documents produced by these countries and their authors and institutions.

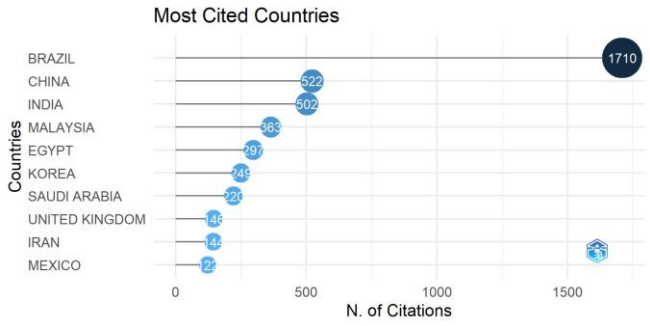

Fig 8. Impact by country

4.2.4. Impact of artícles

The article with the highest impact has 145 citations and deals with a meta-analysis to evaluate trials on gastroprotectors, where there is evidence of ulcer healing and reduction of gastrointestinal bleeding [53]. A study with 124 citations investigated the gastroprotective effect of gallic acid against gastric ulcers and its role in anti-apoptosis. Previously, evidence of its gastroprotective effect was scarce. However, the study demonstrated that gallic acid significantly reduced ulcers and inflammatory markers in rats induced with ulcers by ethanol, highlighting its potential as a gastroprotective agent found in many plants [54]. This alternative indicator to observe the productivity of the articles [55].

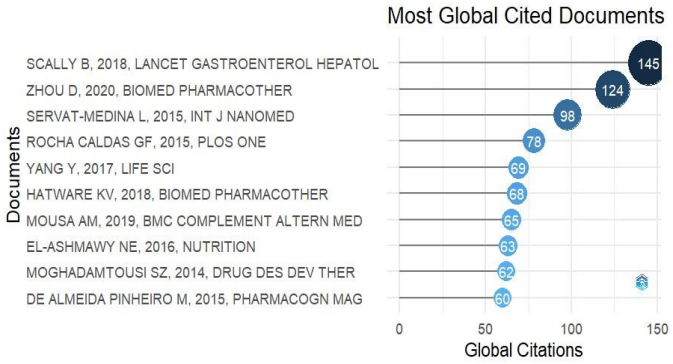

Fig 9. Impact by artícles

4.3. Structure indicators

The clustering of authors and the co-ocurrence of keywords is observed as an important factor in identifying research topics [56].

4.3.1. Collaboration network authors

Six clusters were identified, with the most dominant being that of De Andrade, Boeing, and Da Silva, indicating a high rate of collaboration among them. Two similarly sized clusters belong to Vilegas and Arunachalam, as well as the cluster that includes De Meneses and Wanderley. This collaboration benefits all authors as it brings new ideas and methods for more interdisciplinary research [57].

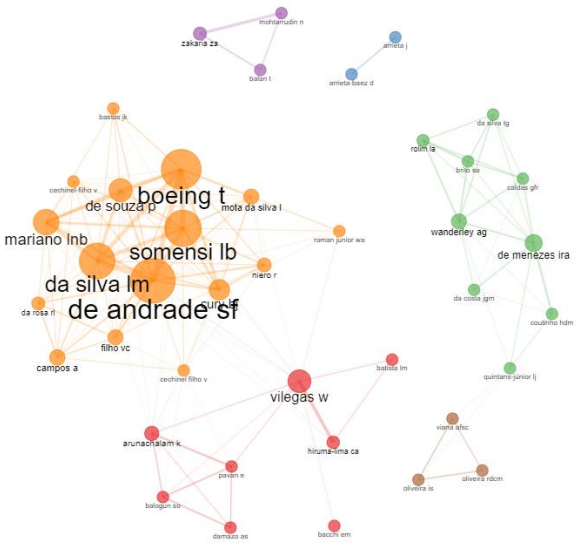

Fig 10. Collaboration network

4.3.2. Coocurrence network keywords

Two distinct clusters are identified: the most dominant focuses on studies about gastroprotectors, extracts, their effects, ulcers, and documents linking these keywords. The second cluster is more centered on studies regarding activity, antioxidants, evaluation, anti-ulcer, and anti-inflammation, showcasing a thematic division within the research on gastroprotective agents, emphasizing the breadth of investigation from compound identification to their therapeutic potential and mechanisms of action [57].

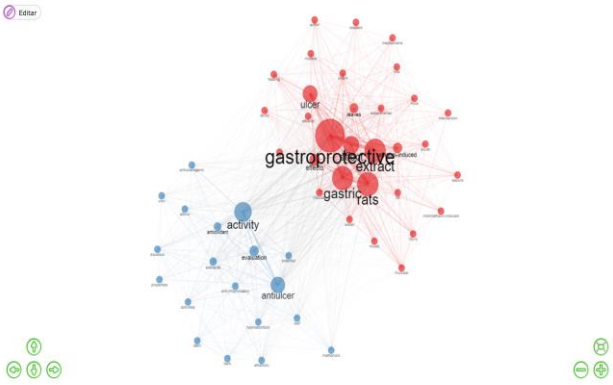

Fig 11. Coocurrence network keywords

CONCLUSIONS

Nutraceuticals and gastroprotectans are a topic of growing interest to many researchers, and more and more and more articles continue to be published evaluating the gastroprotective properties and effects of natural source. It is also an issue that is gaining importance in public health by providing alternative medicine for gastric problems.

Research is oriented towards using sources such as herbs, vegetables, leaves and grains to obtain oils and extracts, which are evaluated for their effects and gastroprotective properties.

Research uses in citro and in vivo assays to determine this gastroprotective effect, mainly using rodents in which gastric ulcers are induced with ethanol.

Articles related to gastroprotectors often contain synonyms in their keywords and titles, so you should review and validate the search results and confirm the relevance of the set.

Brazil is the leading country in research on nutraceutical gastroprotectors, fllowed closely by India and further away by Saudi Arabia and China.

The most significant authors in the field of gastroprotective nutraceuticals are De Andrade, Boeing, Vilegas, and Da Silva. They are recognized not only for the volume of their publications but also for the quality and the number of citations their work receives. Furthermore, their collaborative efforts have contributed positively to the field, leading to meaningful scientific indicators.

The most relevant journal for gastroprotective nutraceuticals is the Journal of Ethnopharmacology, both in number of articles and also in citation count and H-index, which makes it a good option for seeking funding. We cannot fail to mention Evidence-based Complementary and Alternative Medicine, as another good option for funding and publishing.

The keywords show a tendency to co-occur in the case os gastroprotective, extract, activity, ulcer, antiulcer, and ratz, which indicate the high frequency of use in this study area.

It is advisable to go deeper into the subject and establish the niche, driving and emerging topics in order to provide the scientific community with more information on this subject and to help them make decisions on their research and publications.

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