Trends and evolution in the scientific research of *Sechium edule* (Jacq.) Swartz

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ABSTRACT

Objective: Analyze the scientific production on *Sechium edule* by using bibliometric and computer tools to identify trends about its research, as well as the key factors and areas of opportunity that require scientific focus

Design/methodology/approach: The "bibliometrix" package was used to extract, debug and select publications from the Scopus platform. The bibliometric analysis was divided into several sections: the first included an analysis of authors (publication count, H-index); analysis of keywords, as well as trends and areas of opportunity.

Results: It has found 385 documents from 1976 to 2024, with an annual growth rate of 5.12%, 1448 researchers involved, 13,411 references, 12.2 average articles per year published and an average citation of 15.46. 1248 keywords were found, Mexico is the country with the highest number of corresponding authors and with the highest scientific productivity.

Limitations on study/implications: Publications that were not in Scopus or that are in other indexing times were discarded.

Findings/conclusions: Current trends are related to biomedical, pharmaceutical applications through the study of cucurbitacins. Genetic and molecular issues are gaining momentum and more research related to bioprospecting is expected. This information is essential for planning future research and ensuring the continuous and cohesive advancement of the scientific knowledge of chayote.

Keywords: Bibliometrics, biomedical applications, bioprospecting, cucurbitacins.

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INTRODUCTION

Bibliometrics is an essential tool in the field of scientific research for carrying out a metric analysis of academic production. It details the trends, impact and collaborations in a specific area of knowledge (Öztürk *et al.*, 2024). Bibliometric studies analyze and evaluate scientific knowledge in different areas of science, such as agriculture and agronomy. The scope of bibliometrics is to denote the current state of knowledge and

future perspectives: the number of publications, authorship, co-authorship, citations, H-index and factor analysis.

The application of bibliometric studies in agriculture has revealed important patterns in research, such as increasing attention towards sustainability and adaptation to climate change, innovation in cultivation and soil management techniques, as well as the development of pest-resistant crops. and diseases. These trends reflect global priorities to improve food security and environmental sustainability in response to contemporary challenges. Bibliometric studies identify the leading institutions and countries in agricultural research, as well as the researchers with the most visibility and influence, which facilitates the formation of effective collaboration networks and the transfer of knowledge (Safruddin *et al.*, 2024).

In agriculture, bibliometric studies focus on research on climate change as well as its effects on the phenological stages of crops (Wu *et al.*, 2023); extracts or secondary metabolites of fruits and vegetables (Çelik, 2024); smart agriculture and irrigation (Pang *et al.*, 2023); use of biofertilizers (Coutiño-Puchuli *et al.*, 2023 among many other studies. Bibliometric studies are valuable due to their multidisciplinary nature that for agriculture covers fields of knowledge ranging from biotechnology, genetics to agricultural economics and environmental sustainability Agronomy, for its part, focuses on the science and technology of the production and use of plants for food, fuel, fiber and land restoration.

Bibliometric analysis in these fields not only helps to map the current landscape of the research, but also facilitates the identification of key areas of scientific growth, gaps in knowledge and potential opportunities for interdisciplinary collaboration. Therefore, for the purposes of this scientific review, a bibliometric study is essential to identify the aspects related to research. the trend, evolution, areas of opportunity and knowledge gaps around chayote (*Sechium edule*) as a crop of nutritional, economic, pharmaceutical and industrial importance (Cadena-Iñiguez *et al.*, 2007).

The aim of this research is to analyze the scientific production on *Sechium edule* through the use of bibliometric and computer tools to identify trends in its research development as well as the key factors and areas of opportunity that require scientific focus.

MATERIALS Y METHODS

A search was carried out in Scopus by entering the keywords "Sechium edule" omitting the word "chayote" because in other regions globally the fruit may have different names. The digital platform used for this search was Scopus because its complexity, robustness and prestige for access to scientific literature and search offers high quality, wide coverage of scientific journals and indexing of citations, which is essential for an accurate analysis. bibliometric.

The database included other species related to the genus and family Cucurbitaceae. The data were exported from Scopus in comma separated values (CSV) format in order to facilitate management and analysis. The column headings included author names, title of the work, year of publication, keywords, affiliations, abstract, names of the magazines or publishers, among others. For the analysis, the Rstudio program (R Core Team, 2023) and

the "bibliometrix" library (Aria & Cuccurullo, 2017) were used, which is important for the extraction and elimination of duplicates or errors when importing the information.

The bibliometric analysis was divided into several sections, including an author analysis (publication count, H-index); keyword analysis, as well as trends and opportunity areas.

RESULTS AND DISCUSSION

Author analysis

The search carried out in Scopus presented a total of 385 academic documents from 1976 to 2024, with an annual growth rate of 5.12%. The total number of publications consists of 346 scientific articles, 2 book chapters, 19 conference papers, 1 conference review, 1 data paper, 4 notes and 12 reviews.

For these publications, there are a total of 1448 researchers linked to them, of which 16.1% are international collaborations. There is a record of 13,411 references, an average of 12.2 articles published per year and an average citation of 15.46. 1,248 keywords were found, this suggests the plasticity and diversification of research in *S. edule*.

Mexico is the country with the highest number of corresponding authors with a total of 70 documents, followed by India with 49. The entities with the highest number of publications are the Universidad Nacional Autónoma de México with 51, the Sichuan Agricultural University with 40 and the Universidad Veracruzana with a total of 31. Regarding the analysis of authors, Figure 1 shows the list of the main authors in the field of study of *S. edule*, highlighting Mexican scientists.

Keyword analysis

In the search carried out in Scopus, *S. edule*, as the opening scientific name in such analysis, stands out with 12%. Current bioprospecting studies have gained great popularity in recent years, since keywords stand out, such as plant extracts, fruits, unclassified drugs, chemistries, medicinal plants, flavonoids, apoptosis, among others. This suggests advances in pharmaceutical, nutraceutical research and biomedical applications (Figure 2).

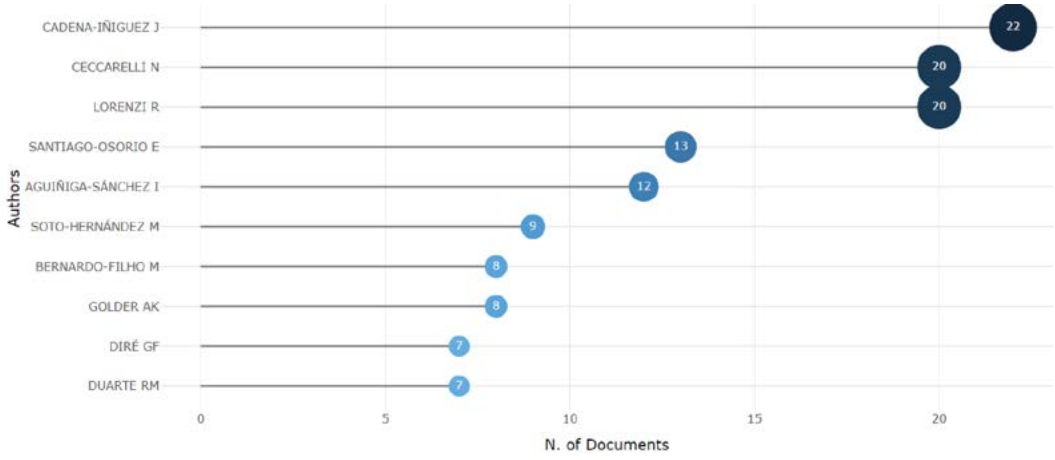

Figure 1. Authors with the highest number of publications on the Scopus platform.

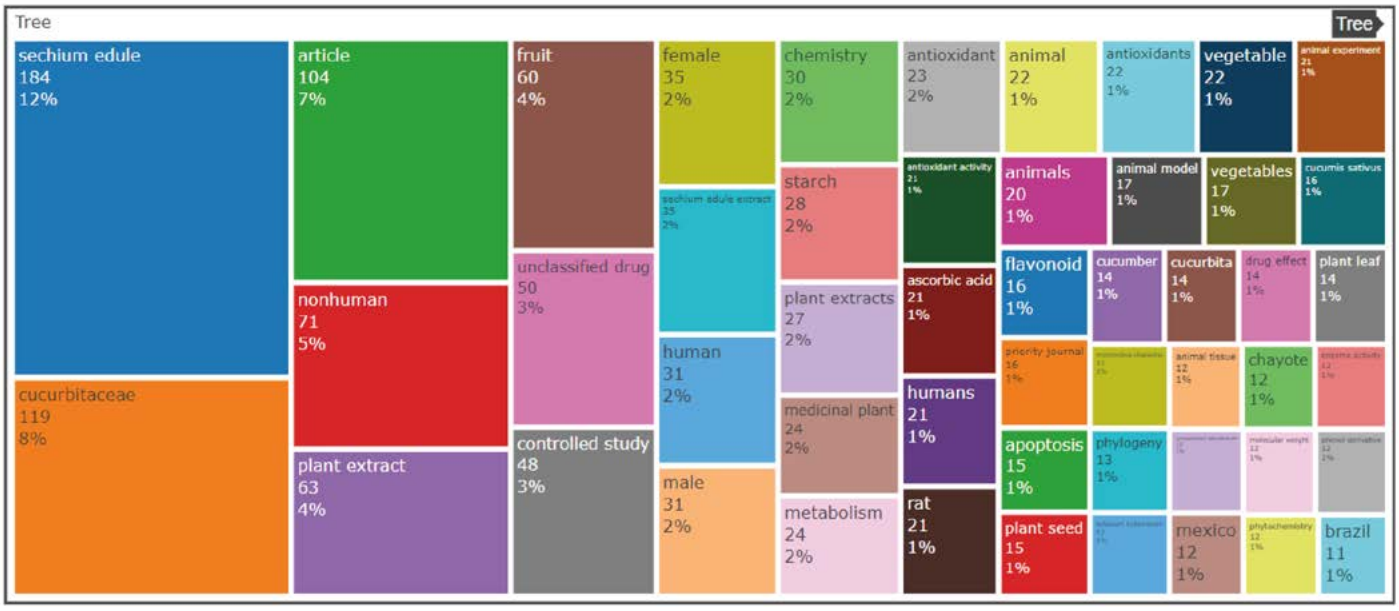

Figure 2. Panel graph with the main keywords from the Scopus database.

Figure 3 shows a network of keywords interconnected by lines that represent the occurrence of these words in scientific publications. Each of the nodes are the keywords and the size is proportional to the frequency of appearance of each keyword based on the database analyzed. The cluster in red focuses on chayote and its related studies. Keywords such as "nonhuman", "plant extract", "antioxidant", and "apoptosis" suggest investigations into the use of chayote extracts in non-human models, possibly exploring their antioxidant properties and effects on apoptosis (programmed cell death). The

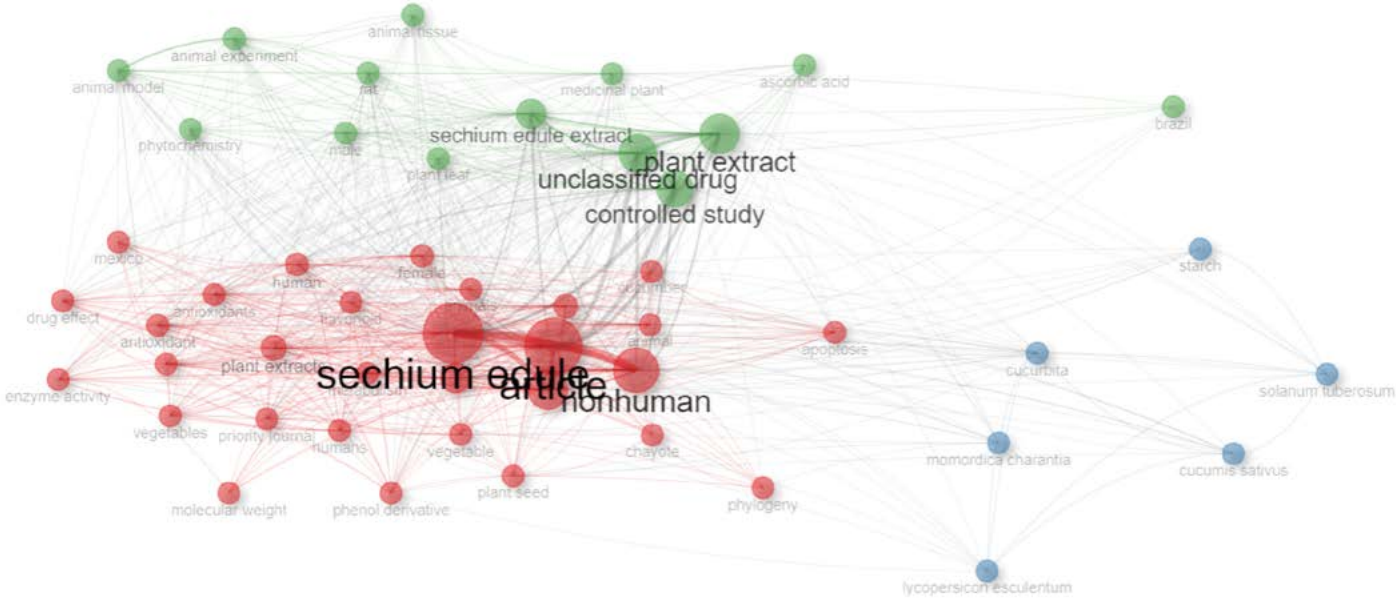

Figure 3. Keyword connectivity, cluster and importance of nodes based on their publication frequency.

connections in which there is a greater density indicate a high degree of interrelation between these themes, showing that studies on chayote are frequently related to research on its biological and chemical effects. The green cluster seems to focus on the use of medicinal plants and their extracts; Keywords such as "animal experiment", "medicinal plant", "ascorbic acid", and "animal tissue" suggest studies focusing on animal experiments and the use of medicinal plants, possibly including ascorbic acid (vitamin C) and its effects on animal tissues. The cluster with the nodes in blue covers different species of the Cucurbitaceae family, such as "*Cucurbita*", "*Solanum tuberosum*", "*Momordica charantia*", and "*Cucumis sativus*", indicating a focus on agronomic and botanical studies focused on starch and other nutritional properties.

Figure 4 shows an analysis of quadrants that indicate the distribution of topics in a research field based on two axes: the degree of relevance (centrality) and the degree of development (density). In the Motor Themes quadrant, it determines that studies on chayote and its use in non-human models are both central and well developed. This suggests that this topic is crucial in current research, with a greater number of publications and a high degree of internal cohesion. In the Basic Themes quadrant, there are themes that are relevant but could benefit from further internal development. Research in the Cucurbitaceae family, on the topic of chemistry and metabolism, is crucial, but could require more studies to consolidate its internal cohesion. In the Niche Themes quadrant, themes are represented that, although not central to the field as a whole, are highly developed and cohesive. Seed physiology, amino acid sequences and genetic studies are specialized areas with a high degree of internal development. In the Emerging or clining themes quadrant, there is the theme of action Potential, this indicates an area that is currently of low relevance and under development; It may represent an emerging topic that has not yet gained significant

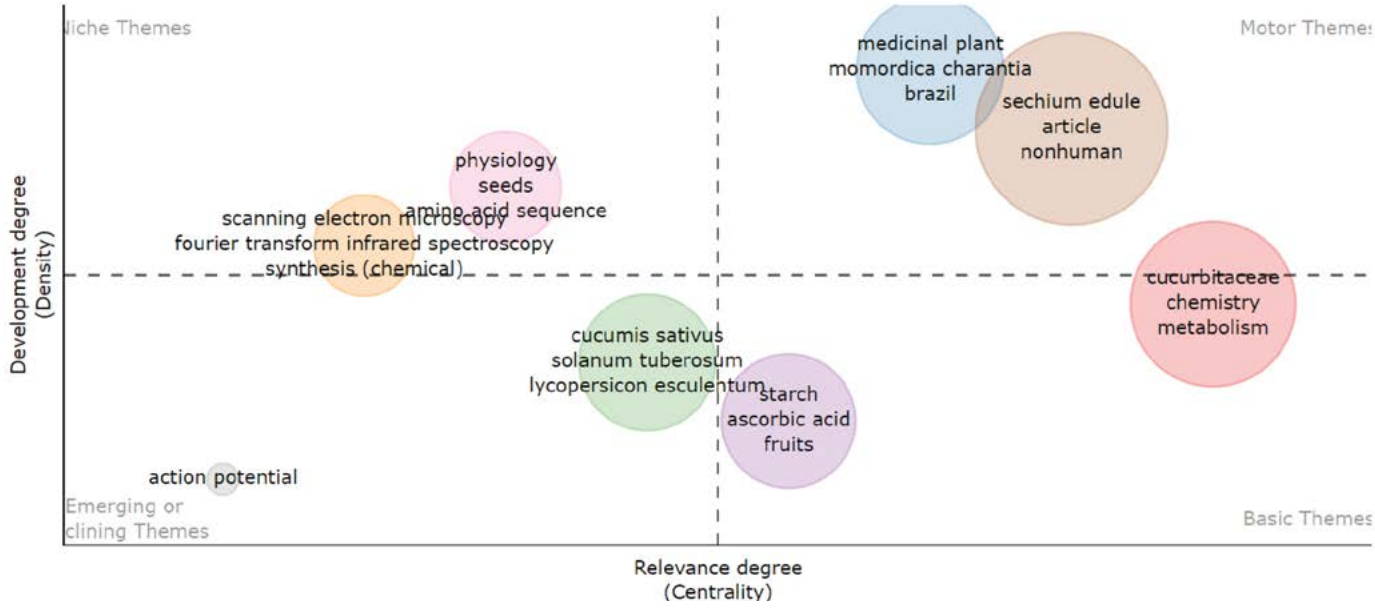

Figure 4. Factor analysis of keywords on the trend in scientific research of *Sechium edule*.

traction in the literature or could be in decline, however, it could be taken up again if bioprospecting studies can be configured.

Figure number 5 shows the areas of opportunity, those with a future perspective such as Drug Effect, Liquid Chromatography, Plant Extract, Human, Antioxidants. Those areas indicate that studies on the effects of drugs, liquid chromatography, plant extracts and antioxidants in humans are both central and well developed. These topics are key in current and future research, a greater proportion of publications and a high degree of internal cohesion are evident. The "Basic Themes" quadrant highlights themes that are fundamental pillars in current research, however they need greater depth and cohesion in their development. Areas of study such as Cucurbitaceae, *Sechium edule*, polysaccharides, phenols, molecular dynamics, zinc oxide, biokinetics, morphology, and analytical techniques such as mass spectrometry are crucial for the advancement of scientific knowledge. Encouraging additional research into these topics will help consolidate their theoretical and practical foundations, enabling the development of innovative applications and technological solutions that can have a significant impact on various industries. Prioritizing these topics on research agendas can lead to important discoveries and technological advances that will benefit multiple sectors. The Niche Themes quadrant represents research areas that have a solid and developed knowledge base but are not fundamental to the field in general. These topics are valuable for their specific applications and for researchers specializing in these areas, although their broader impact and relevance may be limited.

Documentary and experimental research on *S. edule* is very extensive, although publications were only searched in Scopus, there is information in scientific journals indexed from other platforms and for other purposes, for example in scientific dissemination.

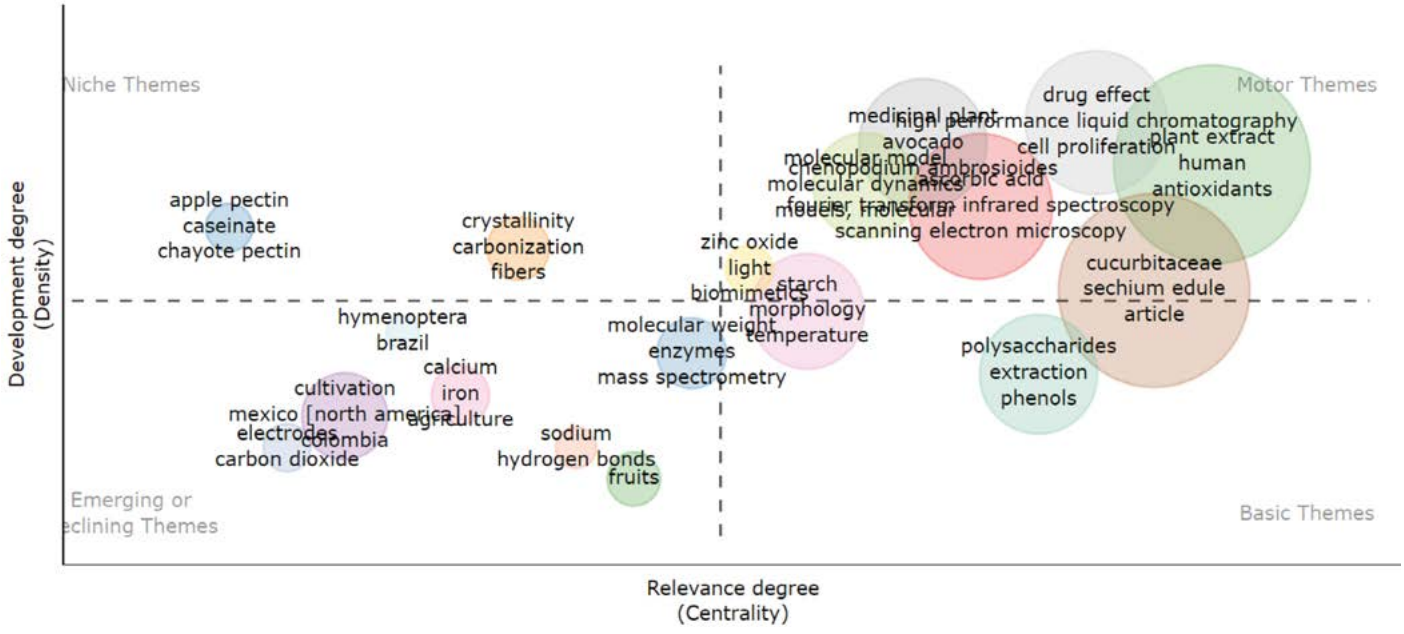

Figure 5. Factor analysis of keywords on the future dynamics and areas of opportunity in scientific research of *Sechium edule*.

CONCLUSIONS

This strategic bibliometric analysis provides a broad overview of the structure and dynamics of research in the field of chayote study. Identify major, core, niche, and emerging themes. It allows researchers and scientific policymakers to conduct their efforts effectively, prioritizing important research areas, supporting the development of innovative topics. This information is essential for planning future research and ensuring the continued and cohesive advancement of scientific knowledge of *S. edule*.

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