Scientometric analysis of scientific production on the genus *Campomanesia* Ruiz & Pav. (Myrtaceae) and most studied species - research trends involving native Brazilian plants

Análise cienciométrica da produção científica sobre o gênero *Campomanesia* Ruiz & Pav. (Myrtaceae) e espécies mais estudadas – tendências de pesquisa envolvendo plantas nativas brasileiras

Análisis cienciométrico de la producción científica del género *Campomanesia* Ruiz & Pav. (Myrtaceae) y las especies más estudiadas: tendencias de investigación que involucran plantas nativas de Brasil

Abstract
Brazil has rich biodiversity, harboring native plants with potential for medicinal use, including species of the *Campomanesia* genus. Although public policies to encourage phytotherapy advocate the best use of plant biodiversity, most species listed in official forms and monographs are exotic species. Thus, the aim of this study is to identify research trends involving the *Campomanesia* and main species, using scientometric tools, so that, by viewing and knowing the scientific production on the genus and species of pharmacological interest, possibilities for research with native species so that they can be integrated into Brazilian’s unified health system (SUS). The research resulted in 302 publications up to September 2021. Bibliometric analyzes on genus were then carried out with data from the WoS platform and social network analysis through of scientometric mapping, using the Vosviewer (VOS) application. Species of the genus with more than 10 publications indexed in WoS were also analyzed. Brazil leads research on the genus and *C. xanthocarpa* (120/302); *C. adamantium* (70/302); *C. pubescens* (33/120); *C. phaea* (25/302); *C. lineatifolia* (21/302) and *C. guazumifolia* (10/302) were the species with the highest publication volume. It is the first work that analyzes the scientific production on these genus of Myrtaceae family and the aforementioned species, which revealed itself a promising field of research, yet little explored, which might encourage new studies aimed at better use of Brazilian biodiversity and the safe and effective use of native plants that may bring benefits to people's health and well-being.

Keywords: Bibliometric; Medicinal plants; Gabiroba; Guavira.

Resumo
O Brasil possui rica biodiversidade, abrigando plantas nativas com potencial para uso medicinal, dentre elas as espécies do gênero *Campomanesia*. Embora as políticas públicas de incentivo à fitoterapia preconizem o melhor aproveitamento da biodiversidade vegetal, a maioria das espécies listadas em formulários e monografias oficiais constitui-se de espécies exóticas. Assim, o alvo deste estudo é identificar as tendências de pesquisa envolvendo *Campomanesia* e principais espécies, usando ferramentas da cienciometria, para que, visualizando e conhecendo a produção científica sobre o tema, abram-se possibilidades de pesquisas com espécies nativas para que possam ser integradas ao Sistema Único de Saúde.
etembro de 2021. Foram realizadas análises bibliométricas sobre o gênero com os dados da plataforma WoS e análises de rede de relacionamento por meio do mapeamento cienciométrico, usando o aplicativo Vosviewer (VOS). Foram analisadas espécies do gênero com mais de 10 publicações indexadas na WoS. O Brasil lidera as pesquisas sobre o gênero e C. xanthocarpa (120/302); C. adamantium (70/302); C. pubescens (33/120); C. phaea (25/302); C. lineatifolia (21/302) e C. guazumifolia (10/302) foram as espécies com mais publicações. É o primeiro trabalho que analisa a produção científica sobre esse gênero da família Myrtaceae e espécies acima mencionadas, o qual revelou um promissor campo de pesquisa, ainda pouco explorado, que pode incentivar novos estudos direcionados ao melhor aproveitamento da biodiversidade e ao uso seguro e eficaz de plantas nativas que possam trazer benefícios a saúde e bem estar das pessoas.

**Palavras chave:** Bibliometría; Plantas medicinais; Gabiroba; Guavira.

1. **Introduction**

Brazil, in its continental dimensions, covers areas with different edaphic, climatic and phytophysiognomic conditions. This variability favored the establishment of different ecosystem formations. The high levels of diversity and degradation due to agropastoral occupation meant that the country had three of its biomes listed among the 25 biodiversity hotspots on the planet (Myers, 2000). In addition to the immense variety of flora and fauna, the country also stands out for its socio-biodiversity, with an invaluable wealth of knowledge and cultures, represented by more than 300 indigenous peoples, quilombola communities, among others that have knowledge about the use and preservation of natural resources. In addition to traditional knowledge and availability of natural resources, the implementation of new technologies can enable the country, in a sustainable way, to increase the research and development of products of natural origin with diverse applicability, especially aimed at improving health and quality of life of people (Valli et al., 2018). However, despite all this heritage, Brazilian biodiversity is underutilized. Most of the national economic activities are based on exotic species in agriculture, livestock and also in extractivism (Brasil, 2021).

The best use of our plant biodiversity is one of the great challenges contemplated in Brazilian public policies. In 2006, the National Policy on Medicinal Plants and Herbal Medicines was created, which established detailed guidelines in the National Program of Medicinal Plants and Herbal Medicines through Interministerial Decree 2.960/2008 (Brasil, 2008), involving 10 ministries. The main objective of the Policy and the Program was to guarantee the Brazilian population safe access and rational use of medicinal and herbal plants, promoting the sustainable use of biodiversity, the development of the production chain and the national industry (Brasil, 2015). Although the guidelines of the herbal medicine policy converge towards the enhancement of local biodiversity, most of the species listed in Brazilian’s national healthcare system (SUS) programs are exotic species (Martins et al., 2019; Medeiros, 2013).
The interest in researching native Brazilian plants of medicinal and pharmacological interest dates back to Brazil Colony, in the court of D. João VI, when the French naturalist Auguste de Saint-Hilaire (1779-1853), on his trips to the interior of Brazil, produced a scientific work that cataloged 283 plants distributed in 53 families. The Fabaceae family was the most representative in the work, with 20 species, followed by Solanaceae, Rubiaceae and Myrtaceae with 12, 10 and 9 species respectively (Brandão et al., 2012).

The Myrtaceae family comprises 5,970 species distributed in 145 genera, including the Campomanesia genus, home to 38 species (The Plant List, 2013), one of them, Campomanesia pubescens, is present in the work of Saint-Hilaire (Brandão et al., 2012). The species of the genus are widely distributed in Brazil and are known for the sweet-acid taste of their fruits. As for the common secondary metabolites for the genus, the phenolic compounds, anthocyanins, chalcones, coumarins, tannins and saponins stand out, in addition to the presence of volatile compounds in its leaves. Evidently there is phytochemical variation between species, but the presence of these classes of compounds could explain the traditional therapeutic use, which is why some species have aroused the interest of researchers, such as: Campomanesia xanthocarpa, Campomanesia adamantium, Campomanesia guazumifolia, Campomanesia reitziana and Campomanesia lineatifolia. Despite the growing publications showing the importance of the genus, not only in the food field, but also in pharmacological applications, there is still a vast field of research to be explored to investigate its potential, especially of native species (Duarte et al., 2020; Lescano et al., 2019).

A research modality that has been standing out in the field of evaluating scientific production and research trends is the scientometric study, whose term was coined by Russian scientist Nalimov and collaborators in the late 1960s. It is the application of quantitative methods on the development of science as an information process, in order to measure scientific production on a given topic, using data analysis tools that allow insights indicative of research trends, such as: research areas, authors, countries, impact of publications, research institutions, funding agents, among others, and the correlations between each variable (Nalimov & Mulchenko, 1971; Van Eck & Waltman, 2010).

Bibliometric research involving scientific production on ethnobotany suggests that this type of study can help formulate public policies that promote the best use and conservation of biodiversity (Ritter et al., 2015). Based on the foregoing, the aim of this study was to analyze, with the aid of scientometric tools, the scientific production of Campomanesia, identifying research trends involving the genus and species of greatest interest so that this overview can stimulate new studies aimed at the use of native plants with biological activities for traditional use and as herbal medicines and thus can be contemplated in public policies to encourage integrative and complementary health practices.

2. Methodology

Survey data were obtained from the Web of Science (WoS). The keyword “Campomanesia” was tested in the “Topic” field of WoS in a previous search along with all the synonyms that appear in The Plant List platform. Only the main name produced results, thus, the search for the term “Campomanesia” in the topic dated until 09/30/2021 generated data for the analysis and scientometric mapping on the genus.

For the analyzes on the species, the term “Campomanesia” was used until 09/30/2021 and in the Filter field, each of the accepted names of species cataloged in “The Plant List” was added separately in spreadsheets organized in order decreasing in the number of publications. For this research, species with 10 or more publications were selected. Then, a Database was generated with each of the species selected according to the established criteria, which were: C. xanthocarpa, C. adamantium, C. pubescens, C. phaea, C. lineatifolia and C. guazumifolia. The information obtained on the indicators for the genus and species was analyzed separately. For the general bibliometric analyses, the WoS analysis tools were used and for the analysis of relationship networks and scientometric mapping, the VOSviewer application was used, based on the technique of visualization by similarities (VOS).
In the present study, for the analysis of relationship networks related to the *Campomanesia* genus, bibliographic coupling and cocitation for citation relationships were used. Figure 1 schematically represents the analysis tools used in this study.

The method applied in scientometric mapping comprises three categories of analysis: citation relationships, word co-occurrence and co-authorship relationships (Li et al., 2021; Van Eck & Waltman, 2010). Citation relationships are the basic principle of scientometric mapping, as it is assumed that the more cited, the more relevant the work (Van Raan & Tijssen, 1993). Citing articles are mapped by bibliographic coupling, while cited articles are mapped by co-citation. Other important tools in scientometric analysis are co-word mapping and co-authorship mapping related to organizations. The first identifies the network of keywords used simultaneously by the authors and thus can reveal the main words and themes about the researched subject. The second reveals the relationship and collaboration networks between authors and institutions (Garfield, 2001).

**Figure 1** – Schematic representation of the methods and analysis tools used in the research.

3. Results and Discussion

3.1 Analysis of the scientific production on genus *campomanesia*

3.1.1 Year and type of publication

The search for the term Campomanesia in the “Topic” field of WoS resulted in 302 publications. The first article indexed in the database was published in 1982, with the title “The development of the fruits and seeds of *Campomanesia* (Myrtaceae)”, published in the periodical Brittonia (Landrum, 1982). The year 2020, a year strongly marked by the Covid-19 pandemic, was the most productive, with 41 publications. Still under the impact of the pandemic, the year 2021 has already registered 29 publications up to the month of September. Figure 2 illustrates the evolution of research on gender over the years, both in number of publications and the evolution of citations and illustrates other numerical information obtained from WoS, such as types of publications, number of countries related to the research; lists open access publications as well as citation report data. Most of the publications found were of the article type (275 out of 302, which comprises 91%); there were 11 review articles (3.7%) and the rest were meeting abstracts, conference articles, notes, among others. The significant proportion of the number of original
articles in relation to review articles suggests that studies with plants of the genus are still scarce, which may mean a potential field of research that is still little explored.

Figure 2 – Evolution of publications on *Campomanesia* genus on Web of Science.

![Graph showing the evolution of publications on *Campomanesia* genus on Web of Science.](image)

From 1982 to 2005 there were a total of 23 published works, corresponding to 7.6% of the 302 publications. From 2006, year of the implementation of public policies to encourage the use of medicinal and herbal plants, until September of 2021, 275 studies were published (92.4%), an indicative that the policies, issued through the Decree of the Presidency of the Republic no 5813 (Brasil, 2006), influenced the production of studies in this field.

3.1.2 Affiliations, countries, regions, research funding and collaboration networks between institutions

Brazil concentrates most of the studies on the *Campomanesia*, with 277 publications (91.7%), followed by the United States of America (USA) with 18 publications; Colombia, 9 studies; Sweden, 5; Spain 4; Argentina, Austria, France, Pakistan and Scotland with 2 publications each and 13 other countries with only one publication. Among these are some with an important history in research on medicinal plants such as China, India, Germany, Japan and Peru. As the species of the genus has an important geographic distribution in Brazil, in areas of tropical, subtropical and Cerrado forests (Landrum, 1986). Brazil's greater interest in researching the species of the genus is justified, and perhaps because of that, the funding agencies that most fostered research were precisely the Brazilian ones. Brazilian’s National Council for Scientific and Technological Development (CNPq) and the Coordination for the Improvement of Higher Education Personnel (CAPES) contributed to the development of 71% of the research, with 119 studies funded by CNPq and 94 funded by CAPES, which corresponds to 39.7% and 31.3% respectively. Table 1 presents the ranking of affiliations that generated at least 5 publications and their origin (by region of Brazil or foreign country).
Table 1 – Ranking of the institutions with 5 or more publications on *Campomanesia* by country or Brazilian region.

| Affiliations                                          | Count | % of 302 | BR Region/Country     |
|-------------------------------------------------------|-------|----------|-----------------------|
| UNIVERSIDADE FEDERAL DA GRANDE DOURADOS               | 44    | 14.6%    | Centro Oeste          |
| UNIVERSIDADE DE SAO PAULO                              | 37    | 12.2%    | Sudeste               |
| UNIVERSIDADE FEDERAL DO PARANA                         | 36    | 11.9%    | Sul                   |
| UNIVERSIDADE FEDERAL DE MATO GROSSO DO SUL             | 30    | 9.9%     | Centro Oeste          |
| UNIVERSIDADE ESTADUAL DE MATO GROSSO DO SUL            | 27    | 8.9%     | Centro Oeste          |
| EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA           | 21    | 6.9%     | Nacional              |
| UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL              | 20    | 6.6%     | Sul                   |
| UNIVERSIDADE ESTADUAL DE CAMPINAS                      | 17    | 5.6%     | Sudeste               |
| UNIVERSIDADE FEDERAL DE GOIAS                         | 17    | 5.6%     | Centro Oeste          |
| UNIVERSIDADE FEDERAL DE LAVRAS                         | 14    | 4.6%     | Sudeste               |
| UNIVERSIDADE FEDERAL DE SANTA MARIA                    | 14    | 4.6%     | Sul                   |
| INSTITUTO FEDERAL DO RIO GRANDE DO SUL                 | 14    | 4.6%     | Sul                   |
| UNIVERSIDADE FEDERAL DE SANTA CATARINA                 | 13    | 4.3%     | Sudeste               |
| UNIVERSIDADE ESTADUAL PAULISTA                         | 9     | 2.9%     | Sudeste               |
| UNIVERSIDADE ESTADUAL DE MARINGA                        | 8     | 2.7%     | Sul                   |
| UNIVERSIDADE FEDERAL DE MINAS GERAIS                   | 8     | 2.7%     | Sudeste               |
| ARIZONA STATE UNIVERSITY                                | 7     | 2.3%     | EUA                   |
| INSTITUTO FEDERAL GOIANO                               | 7     | 2.3%     | Centro Oeste          |
| UNIVERSIDADE DO ESTADO DE SANTA CATARINA               | 7     | 2.3%     | sul                   |
| UNIVERSIDADE FEDERAL DE UBERLANDIA                     | 7     | 2.3%     | Sudeste               |
| UNIVERSIDADE DE CRUZ ALTA                              | 6     | 2.0%     | Sul                   |
| UNIVERSIDADE FEDERAL DE SAO CARLOS                     | 6     | 2.0%     | Sudeste               |
| INSTITUTO FEDERAL DE GOIAS IFG                         | 5     | 1.7%     | Centro Oeste          |
| UNIVERSIDAD NACIONAL DE COLOMBIA                       | 5     | 1.7%     | Colômbia              |
| UNIVERSIDADE DE BRASILIA                               | 5     | 1.7%     | Centro Oeste          |
| UNIVERSIDADE ESTADUAL DE FEIRA DE SANTA                  | 5     | 1.7%     | Nordeste              |
| UNIVERSIDADE ESTADUAL DE GOIÁS                         | 5     | 1.7%     | Centro Oeste          |
| UNIVERSIDADE FEDERAL DO PAMPA                          | 5     | 1.7%     | Sul                   |
| UNIVERSIDADE LUTERANA DO BRASIL                        | 5     | 1.7%     | Sul                   |
| UNIVERSIDADE TECNOLOGICA FEDERAL DO PARANA             | 5     | 1.7%     | Sul                   |

Source: Authors.

Table 2 presents the data above classified by number of publications by regions of Brazil and foreign country. It is observed that among the affiliations with more than 5 publications, the Midwest Region (CO) was the most representative with 39.2% of publications, followed by the South Region with 32.5% and the Southeast with 27.2%. USA and Colombia were the countries with affiliations that published at least 5 articles. The data were further subclassified by states, where Mato Grosso do Sul (MS) leads the ranking with 102 studies, followed by São Paulo (SP), Rio Grande do Sul (RS), Paraná (PR), Goiás (GO), Minas Gerais (MG), Santa Catarina (SC) and Distrito Federal (DF) with 69, 50, 49, 34, 29, 18 and 5 publications respectively. Fruits of *Campomanesia spp*, known as “guavira”, since 2017 is considered a symbol of the state of Mato Grosso do Sul, established by state law (Mato Grosso do Sul, 2017). Plants of the *Campomanesia* can be found in Colombia, according to the Missouri Botanical Garden (tropicos.org). They are also distributed in the 5 Brazilian regions and in the Phytogeographic Domains: Amazon, Caatinga, Cerrado, Atlantic Forest and Pampa (Oliveira; Costa & Proença, 2020).
This study also analyzed the relationships between authors and institutions, represented by Figure 3, in which the VOS generated a map that included 194 institutions. Applying a filter of a minimum of 3 documents per organization, resulted in 39 items, of which 33 are correlated and divided into 6 clusters, 92 links and total link strength 210. Cluster 1, indicated by the red color, corresponds to groups and institutions in Rio Grande do Sul (Unicruz, Univ. Fed. Pampas, UFRGS, Univ Fed. Santa Maria); Santa Catarina (UFSC), Paraná (PUC-PR) and the University of Brasília, which although belonging to the Midwest region, are more closely related to this group. Cluster 2 indicated by the color green is representatively listed by the Brazilian Agricultural Research Corporation (Embrapa) of national scope and 4 institutions in the state of Paraná.

**Table 2** – Share of publications by Brazilian regions or countries (a) and by Brazilian states (b)

| Brazilian region / Country | Publications | Share |
|---------------------------|-------------|-------|
| Midwest                   | 141         | 39.2% |
| South                     | 117         | 32.5% |
| Southeast                 | 98          | 27.2% |
| Northeast                 | 1           | 0.3%  |
| National scope (Embrapa)  | 1           | 0.3%  |
| USA                       | 1           | 0.3%  |
| Colombia                  | 1           | 0.3%  |
| **Total**                 | **360**     | **100.0%** |

| Brazilian state | Publications | Share |
|-----------------|-------------|-------|
| MS              | 102         | 28.7% |
| SP              | 69          | 19.4% |
| RS              | 50          | 14.0% |
| PR              | 49          | 13.8% |
| GO              | 34          | 9.5%  |
| MG              | 29          | 8.1%  |
| SC              | 18          | 5.1%  |
| DF              | 5           | 1.4%  |
| **Total**       | **356**     | **100.0%** |

Source: Authors.

**Figure 3** – Network of relationship between authors and institutions with publications on genus *Campomansesia*.

Source: Authors.

### 3.1.2 Journals, Impact Factor and research fields

Figure 4 graphically illustrates the relationship between the number of publications by research area, the most representative being: Agriculture, Plant Sciences, Food Science Technology, Pharmacology Pharmacy and Chemistry, indicating research trends for application in the field of agricultural sciences, food and nutrition and applications of pharmacological interest. Below, Table 3 and Figure 5 which respectively illustrate the ranking of journals with 5 or more publications and their...
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respective Impact Factor according to the Incites Journal Citation Reports (JCR) belonging to Clarivate Analytics and the network map involving the relationships of co-citation between journals, based on the strength of term density. The data presented lead to the reflection that titles with a higher Impact factor achieve greater relevance in terms of impact on citations than, for example, the journal with the highest number of publications, despite having a smaller number of publications. In the case of this study, the Food Research International and the Journal of Ethnopharmacology are the journals with higher impact, with an Impact Factor of 6.475 and 4.360 respectively.

**Figure 4** – Number of publications by research areas.

![Research Areas](image)

**Table 3** – Number of publications and percentage from journals with 5 or more publications and their respective impact factor (JCR).

| Titles of Publications                  | Count | % of 302 | Impact Factor - JCR (2020) |
|----------------------------------------|-------|----------|---------------------------|
| REVISTA BRASILEIRA DE FRUTICULTURA     | 16    | 5,3%     | 0.912                     |
| JOURNAL OF ESSENTIAL OIL RESEARCH     | 11    | 3,7%     | 1.963                     |
| JOURNAL OF ETHNOPHARMACOLOGY          | 11    | 3,7%     | 4.360                     |
| ACTA BOTANICA BRASILICA               | 6     | 2,0%     | 1.268                     |
| BRITTONIA                              | 6     | 2,0%     | 0.863                     |
| CIENCIA FLORESTAL                     | 6     | 2,0%     | 0.574                     |
| FOOD RESEARCH INTERNATIONAL           | 6     | 2,0%     | 6.475                     |
| BRAZILIAN JOURNAL OF PHARMACOGNOSY    | 6     | 2,0%     | 2.010                     |
| ACTA HORTICULTURAE                    | 5     | 1,7%     | Not found in JCR          |
| CIENCIA RURAL                          | 5     | 1,7%     | 0.803                     |
| NATURAL PRODUCT RESEARCH              | 5     | 1,7%     | 2.861                     |

Source: Authors.
Figure 5 – Density map of co-citation relationships and their respective journal title.

Source: Authors.

3.1.4 Most cited articles and co-occurrence relationships of keywords between authors

Table 4 illustrates the 10 most cited articles, by year of publication, the total number of citations, as well as the evolution in the number of citations in the last 5 years, with the data for the year 2021 referring to the month of September when the data were collected. Reading the titles, abstracts and keywords shows that of the 10 most cited articles, 8 investigate biological activities, demonstrating the pharmacological interest of the species of the genus; one of the articles reveals interest in cultivation and propagation and the other in the field of food and beverages, which investigates the potential of *C. pubescens* fruits in the production of fermented beverages (Duarte *et al.*, 2009). In this list of articles, the most studied species was *C. xanthocarpa* (5 out of 10 publications), 2 of which related to antioxidant potential, 2 related to weight loss (one of which also assesses the improvement of biochemical parameters such as blood glucose and lipid profile) and one that demonstrated an antiulcer effect. Another species present in the list of the 10 most cited articles is *C. adamantium* (one of the researches used the synonymous term *Campomanesia cambossedeva* with 2 publications. One of them investigates antioxidant and antiproliferative activity (Malta *et al.*, 2013) and another investigates anti-inflammatory and antinociceptive activity (Ferreira *et al.*, 2013).
The co-occurrence analysis of keywords in the database on the *Campomanesia* genus is described in Figure 6. The genus’ database generated a total of 1507 keywords. It was limited the minimum number of occurrences per word to 5, which generated 75 items divided into 6 clusters, 857 links, with 1608 being the total strength of the link. The overlay view displays keywords by publication time, which allows inferences about current research trends on the topic. It is observed that the *Myrtaceae* family appears more significantly because it is the family to which the genus belongs and may also reveal the interest of researchers in the family that houses numerous species of interest in the most diverse areas. *Campomanesia xanthocarpa* is a relevant term (34 occurrences, 45 links) linked to words that denote potential antimicrobial activity, but also related to words that indicate antioxidant and anti-inflammatory activities in recent research related to words that indicate antioxidant and anti-inflammatory activities. The term "antioxidant activity" comes up with 51 hits and 2020. It is noted that the terms related to antioxidant activity are yellow, indicating that they are the most recent research, as well as the term savannah (16 occurrences, 29 links), suggesting a research trend towards biological activity with species from this Brazilian biome. *Campomanesia adamantium* was also a relevant term (13 occurrences, 22 links), in lilac color, which indicates older research that may be related to the traditional use linked to antimicrobial activity, but also related to words that indicate antioxidant and anti-inflammatory activities in recent research (Oliveira et al., 2016). The term “antimicrobial activity” had 11 hits and 35 links, while the term “antioxidant activity” comes up with 51 hits and 57 links.

| Title                                                                 | Year | Authors                                                                 | 2017 | 2018 | 2019 | 2020 | 2021* | All years |
|-----------------------------------------------------------------------|------|--------------------------------------------------------------------------|------|------|------|------|-------|-----------|
| Characterization and Antioxidant Potential of Brazilian Fruits from the Myrtaceae Family | 2012 | Pereira, M.C.; Steffens, R.S.; Iablonzki, A.; Herz, P.F.; Rios, A.O.; Vizzotto, M.; Flores, S.H. | 7    | 9    | 19   | 21   | 14    | 86        |
| Plants popularly used for loosening weight purposes in Porto Alegre, South Brazil | 2007 | Dickel, M.L.; Kuze-Rates, S.M.; Ritter, M.R. | 6    | 4    | 3    | 4    | 5     | 78        |
| Reproductive-Biology of 8 Sympatric Myrtaceae from Central Brazil     | 1994 | Proença, C.E.B.; Gibbs, P.E. | 4    | 8    | 0    | 5    | 4     | 73        |
| Preliminary studies on *Campomanesia xanthocarpa* (Berg.) and Cuphea carthagenensis (Jacq.) JF Machr. | 2004 | Biavatti, MW; Farias, C; Curtius, F; Brasil, LM; Hort, S; Schuster, L; Leite, SN; Prado, SRT | 1    | 3    | 4    | 7    | 4     | 58        |
| Antiinflamatory effects of *Campomanesia xanthocarpa*                  | 2004 | Markman, BEO; Bacchi, EM; Kato, EFM | 5    | 5    | 2    | 8    | 2     | 56        |
| Indigenous and inoculated yeast fermentation of gabiroba (Campomanesia pubescens) pulp for fruit wine production | 2009 | Duarte, W.F.; Dias, D.R.; Melo Pereira, G.V.; Gervasio, I.M.; Schwan, R.F. | 6    | 2    | 4    | 2    | 2     | 55        |
| Assessment of antioxidant and antiproliferative activities and the identification of phenolic compounds of exotic Brazilian fruits | 2013 | Malta, L.G.; Tessaro, E.P.; Eberlin, M.; Pastore, G.M.; Liu, R.H. | 6    | 9    | 5    | 2    | 6     | 46        |
| Total fenolics and condensed tanins in native fruits from brazilian savanna | 2011 | Rocha, W.S.; Lopes, R.M.; Silva, D.B.; Vieira, R. F.; Silva, J.P.; Agostini-Costa, T.S. | 8    | 2    | 10   | 10   | 4     | 46        |
| Volatile components and antioxidant activity from some myrtaceous fruits cultivated in Southern Brazil | 2008 | Marun, R.; Apel, M.A.; Limberger, R.P.; Raseira, M.C.B.; Pereira, J.F.M.; Zuanazzi, J.A.S.; Henriques, A.T. | 2    | 5    | 4    | 3    | 4     | 45        |
| Anti-inflammatory and antinociceptive activities of *Campomanesia adamantium* | 2013 | Ferreira, L.C; Grabe-Guimarães, A.; Paula, C.A.; Michel, M.C.P.; Guimarães, R.G.; Rezende, S.A.; Souza Filho, J.D; Saude-Guimarães, D.A. | 8    | 10   | 4    | 2    | 1     | 43        |

Source: Authors.

Table 4 – Top 10 most cited articles by year, authorship, total citations and evolution of citation in the last 5 years.
3.1.5 Contributions on authors and network collaboration between authors (bibliographic coupling)

Research involving the *Campomanesia* genus is concentrated in a few researchers, as shown in Table 5, which lists, in descending order, the number and percentage of contributions by authors who produced 5 or more publications. It is observed that only 18 authors are responsible for more than 45% of publications. The author Claudia Andrea Lima Cardoso leads the ranking with 25 publications on the subject, which corresponds to 8.3% of the publications. The author is affiliated with the Natural Resources Center of the State University of Mato Grosso do Sul (UEMS), has 245 publications, was cited 1,802 times with an average citation of 8.4 citations/document, presents H-Index 21. The document most cited (90 citations) was published in March 2014 in the journal Food and Chemical Toxicology with the title “Antimicrobial, antioxidant and cytotoxic activities of propolis from Melipona orbignyi (Hymenoptera, Apidae)”. The journals with the most publications by the author are the Journal of Ethnopharmacology (21); Orbital – The electronic Journal of Chemistry (12); Journal of Essential Oil Research (9) and Plos One (7).

| Authors          | Count | % of 302 |
|------------------|-------|----------|
| Cardoso CAL      | 25    | 8.3%     |
| Vieira MD        | 13    | 4.3%     |
| Dresch DM        | 9     | 3.0%     |
| Landrum LR       | 9     | 3.0%     |
| Scalon SDQ       | 8     | 2.6%     |
| Re-poppo N       | 7     | 2.3%     |
| Viecili PRN      | 7     | 2.3%     |
| Kassuya CAL      | 6     | 2.0%     |
| Klafke IZ        | 6     | 2.0%     |
| Barbieri SF      | 5     | 1.7%     |
| Boas EVDV        | 5     | 1.7%     |
| Funch LS         | 5     | 1.7%     |
| Guimaraes RDA    | 5     | 1.7%     |
| Hiane PA         | 5     | 1.7%     |
| Petkowicz CLD    | 5     | 1.7%     |
| Salvador MJ      | 5     | 1.7%     |
| Santos MD        | 5     | 1.7%     |
| Silveira JLM     | 5     | 1.7%     |
| **Total**        | **137** | **45.7%** |

Source: Authors.
Figure 7 presents the relationship map of bibliographic coupling between authors, in which it can be seen different clusters of authors. Bibliographic coupling occurs when 2 or more citing articles are related through the same retrospectively cited articles. The research limited to authors with 3 or more publications and who received at least 1 citation, thus generating the map with 59 items, divided into 5 clusters, 1164 links and 34,318 the total strength of the link. Coupling strength is determined by the number of quotes they share. The greater the coupling force, the stronger the relationship between authors. It is observed that research involving the *Campomanesia* genus is restricted to a few groups, with a strong relationship between them, and that the authors Cardoso, Claudia AL (green cluster) and Vieira, Maria DC (red cluster) are the most productive with 8.3% and 4.3% of publications respectively.

Figure 7 - relationship map of bibliographic coupling between authors.

3.1.6 Co-citation networks and cited references - theoretical pillars

The analysis of the co-citation network, together with the cited references, indicate the theoretical pillars that underlie the database research on the *Campomanesia* genus. Figure 8 represents this network of connections and was built in the VOS, limiting to a minimum of 10 cited references. Therefore, the analysis of the 7,737 cited references that make up the database for the Campomanesia genus, limited to a minimum of 10, generated 65 items, divided into 5 clusters, 1,039 links and 5,132 link strength. Klafke, J.Z., belonging to cluster 1, in red, was cited 66 times, with 52 links and 529 total link strength. Cluster 2, in green, has as main reference Landrum, L with 69 citations, 51 links and 419 the strength of the link. Lorenzi, H. and Vallilo, MI (from clusters 3 and 4 respectively) are the most cited authors, both with 90 citations, but they differ in the number of links (59 and 64 respectively) and the strength of the link (524 and 575 respectively), which gives Vallilo, MI leadership as a theoretical reference for research on the studied genus.
3.2 Most researched and researched species of the campomanesia genus in the last 5 years

For the analysis of the most searched species in the WoS database, it was added a filter with the name of each of the 38 species with names accepted by The Plant List platform (theplantlist.org), considering synonymous terms, then it was selected species with 10 or more publications. The species *C. xanthocarpa* and *C. adamantium* lead the ranking with 120 and 70 species respectively. Table 6 illustrates the 6 species with the total number of publications; the number of publications from 2017 to September 2021 and the representative percentage of studies in the last 5 years. It is observed that the species *C. guazumifolia*, from this list, is the one with the fewest studies, but the majority (80%) occurred in the last 5 years, suggesting a recent interest in its potential. On the other hand, *C. lineatifolia* presented only 1 study in the last 5 years, more specifically in 2021.

### Table 6 – Species of the Campomanesia genus with 10 or more studies in WoS, total publications, publications in the last 5 years and the percentage they represent for each species.

| Species of Campomanesia | Total of publications | Publications 2017 - 2021 | % of publications in last 5 years |
|-------------------------|-----------------------|---------------------------|----------------------------------|
| *C. xanthocarpa*         | 120                   | 59                        | 49.2%                            |
| *C. adamantium*          | 70                    | 32                        | 45.7%                            |
| *C. pubescens*           | 33                    | 13                        | 39.4%                            |
| *C. phaea*               | 25                    | 17                        | 68.0%                            |
| *C. lineatifolia*        | 21                    | 1                         | 4.8%                             |
| *C. guazumifolia*        | 10                    | 8                         | 80.0%                            |

Source: Authors.

3.2.1 *Campomanesia xanthocarpa*

*C. xanthocarpa* (Mart) O.Berg, a native and non-endemic species of Brazil, is a semi-deciduous tree, with a tall, dense, pyramidal crown that measures from 4m to 20m in height; vegetation type Seasonal Semideciduous Forest, Ombrophilous Forest and Mixed Ombrophilous Forest; common in the Pampa and Atlantic Forest phytogeographic domains. The fruit, popularly known as gabiroba, has a greenish-yellow color, measures approximately 3 cm in diameter, has a firm, succulent pulp and a sweet taste, being highly appreciated for fresh consumption, in liqueurs, juices, ice cream and jellies (Fern, 2014a; Oliveira, M. I. U.; Costa, I. R.; Proença, 2020) It is a plant of pharmacological interest due to its anti-inflammatory properties (Cardozo et al., 2018; Silva et al., 2016; Viecili et al., 2014); antihypercholesterolemic (Klafke et al., 2010); antioxidant (Oliveira et al., 2016;
Salmazzo et al., 2021); antidiabetic (Vinagre et al., 2010); antiulcerogenic (Markman et al., 2004), antinociceptive (Leandro et al., 2020); anti-obesity (Biavatti et al., 2004; Dickel et al., 2007); antidiarrheal (Souza-Moreira et al., 2011); antimicrobial (Capeletto et al., 2016), among others.

3.2.1.1 Campomanesia xanthocarpa – Bibliometric Analysis

The search for the term *C. xanthocarpa* in WoS, the most researched species of the genus in this database, resulted in 120 publications, 108 articles, 8 review articles, 4 early access documents and 4 meeting abstracts. The two years with the most indexed searches were 2020 with 22 publications (18.3%) and 2021, which until the month of September registered 12 publications. Most publications in these 2 years were 27 of the article type and only 4 reviews, which indicates that the research, with all the difficulties imposed by the Covid-19 pandemic, has not stopped. The country that most investigates the species is Brazil (115/120 = 95.8%), followed by the USA (6/120 = 5%) and Sweden (3/120 = 2.5%); The authors who published the most were: Cardoso C.A.L (13/120 = 10.8%); Viecili P.R.N. (7/120 = 5.8%); Klafke J.Z. and Re-Poppi N (6/120 = 5% each). Most authors are affiliated with the Federal University of Paraná (UFPR – 27/120 = 22.5%); State University of Mato Grosso do Sul (UEMS – 16/120 = 13.3%) and Federal University of Rio Grande do Sul (UFRGS – 15/120 = 12.5%), which indicates the interest of institutions in studying in plants from their own region. The journals with the highest number of publications were: Journal of Essential Oil Research and Journal of Ethnopharmacology with 7 publications each (5.8%); Forestry Science (5/120 = 4.2%) and Natural Product Research (4/120 = 3.3%). The most researched areas were: Food Science Technology (25/120 = 20.8%); Chemistry (24/120 = 20%); Pharmacology Pharmacy (21/120 = 17.5%); Plant Science and Agriculture (19/120 = 15.8%). These analyzes suggest Brazil's growing interest in investigating the potential of native species such as *C. xanthocarpa*, in the field of food and nutrition, agriculture and cultivation, and as a potential pharmacological application.

3.2.1.2 *C. xanthocarpa* – Co-occurrence network analysis by keywords

The co-occurrence relationship of words in research on the species shows the main keywords, and the relationship between them, which allows for the identification of the main themes addressed by the articles. For the construction of the VOS map, shown in Figure 8, we selected the All Keywords option and limited it to 3 occurrences per word, which generated 772 words in 61 items, divided into 7 clusters, 380 links, with a total link strength of 680. Figure 9 shows the overlay map visualization, indicating the use of terms over the years, which may suggest current research trends. It is observed that cluster 1, in green, presents the relevance of the keyword “Antioxidant activity”, which is also related to cluster 3 with the word “Oxidative stress” in yellow, both are linked to related terms such as “polyphenols”, “phenolic compounds”, “atherosclerosis”, “quercetin”, among others, indicating a strong research tendency of the species for this activity. Other words related to biological activities that appear relevantly are: “antimicrobial activity”, “obesity” and “cholesterol.”
3.2.2 Campomanesia adamantium

*C. adamantium* (Cambess.) The Berg, popularly known as “guabiroba do campo”, is a native and non-endemic species in Brazil with geographic distribution in the Brazilian Midwest (Federal District, Goiás, Mato Grosso do Sul, Mato Grosso); Southeast (Minas Gerais, São Paulo) and South (Paraná, Santa Catarina) in the Cerrado and Atlantic Forest phytogeographic domains. It presents itself as a variable shrub that grows from 50 to 150 centimeters. Its fruits are also variable in size, color and degree of astringency. They have a succulent pulp with an acid-sweet flavor and are generally harvested in the field and consumed fresh (Oliveira; Costa & Proença, 2020). Among the main biological activities investigated in the species are: antimicrobial activity (Sá *et al.*, 2018), antioxidant (Coutinho *et al.*, 2010), anti-inflammatory and anti-nociceptive (Viscardi *et al.*, 2017).

3.2.2.1 *C. adamantium* – Bibliometric Analysis

The search for the term *Campomanesia adamantium* in WoS resulted in 70 publications, 65 articles, 2 reviews, 2 corrections and 1 meeting summary. The most productive years were 2016 and 2017 with 11 and 9 publications (15.7% and 12.9%) respectively, followed by 2019 and 2018 (7/70 = 10% each). Brazil is the country that most contributes to research with 98.6% of publications and USA and Colombia, 1.4%. The research areas with the most publications were Agriculture (17/70 = 24.3%), Pharmacology Pharmacy (13/70 = 18.6%) and Food Science Technology (11/70 = 15.7%), indicating interest in cultivation and agriculture, pharmacological and food. The most productive authors were: Cardoso C.A.L with 11 publications (16.9%); followed by Vieira M.D. and Dresch D.M. with 13.8% and 10.8% of publications respectively. The main affiliations of the authors are: Federal University of Grande Dourados (UEGD – 29/70 = 41.4%); Federal University of Mato Grosso do Sul (UFMS – 16/70 = 22.9%); State University of Mato Grosso do Sul (UEMS – 13/70 = 18.6%); Federal University of Goiás (UFG – 11/70 = 15.7%) and University of São Paulo (USP – 10/70 = 14.3%). It is observed that the state of Mato Grosso do Sul contributes with more than 80% of the researches.
3.2.2.2 *C. adamantium* – Co-occurrence network analysis by keywords

The analysis of the occurrence of keywords for the species *C. adamantium* in the VOS is shown in Figure 10 and was limited to 3 occurrences per word. Therefore, from 392 keywords found, 41 items were generated, 6 clusters, 242 links and 376 the total strength of the link. The overlay view shows that the most recently used words are related to antioxidant activity and antiproliferative activity. The term "Savannah" (in yellowish-green) appears in a relevant way with 12 occurrences, which may indicate a research trend in native plants of this biome with potential biological activity, among them: antioxidant activity (12 occurrences), antimicrobial activity (4 occurrences) and antiproliferative activity (3 occurrences).

**Figure 10** - Scientometric mapping of keywords co-occurrences – *C. adamantium.*

3.2.3 *Campomanesia pubescens*

*C. pubescens* (Mart. ex DC.) O. Berg is the accepted name of this species native to Paraguay and Brazil (Northeast, Southeast, South and Midwest) which has 53 synonyms, according to the Royal Botanic Gardens (KEW), through the Tropicos.org platform (2021). Popularly known as "downy guabiroba", it has the form of a deciduous shrub, present in the geographical domains of the cerrado, caatinga and Atlantic forest, it can reach 2m in height and the fruits, with a succulent pulp and acidic flavor, are generally harvested and consumed locally (Fern, 2014b). Some biological activities are attributed to the species, such as antimicrobial (Cardoso *et al.*, 2010); antioxidant (Chang *et al.*, 2011); metabolic dysfunctions (Cardozo *et al.*, 2018) and even anxiolytic and anti-depressant activities (Villas Boas *et al.*, 2020).

3.2.3.1 *C. pubescens* – Bibliometric Analysis

The search for the species name in WoS presented 33 results, 29 articles and 2 reviews, 1 correction and 1 Conference article. The most productive years were 2009 and 2018, both with 5 publications (15.1%) and 2011 and 2020 with 4 publications each (12.1%). The vast majority of surveys are Brazilian (31/33 = 93.9%). USA and Spain have 2 publications each and with 1 publication, there are Mexico, Scotland and Venezuela. The interest of Brazil is explained by being a native species, on the other hand, Paraguay, which is also home to the species, has not registered any study in WoS. The most productive authors were
Cardoso C.A.L. (9/33 = 27.3%); Villas Boas GR, Silveira A.P.S., Osterreich S.A. and Reppopi N with 3 publications each (9.1%). The main affiliations of the authors are: State University of Mato Grosso do Sul (UEMS – 9/33 = 27.3%); Federal University of Lavras (UFLA – 6/33 = 18.2%); Federal University of Grande Dourados (UFGD) and Federal University of Mato Grosso do Sul (UFMS) with 5 studies each, totaling 15.2%. Once again, the predominance of research in institutions in the state of Mato Grosso do Sul is noted.

3.2.3.2 *C. pubescens* – Co-occurrence network analysis by keywords

Figure 1 illustrates the map of keyword co-occurrence analyzes for the species *C. pubescens*. The minimum number of occurrences of keywords considered for this analysis was 2. Therefore, the 212 keywords were distributed into 35 items, 6 clusters, 154 links and 203 total link strength. Figure 1 represents the co-occurrence networks of these words in an overlay view. It is observed that the term *Campomanesia xanthocarpa* with 5 occurrences and the term *Campomanesia lineatifolia* with 3 occurrences, suggesting that these species have been researched together with *C. pubescens*. Note, as in the species described above, the relevance of the terms linked to antioxidant activity (8 occurrences, 20 links) and oxidative stress (2 occurrences, 8 links) in shades ranging from light green to yellow, indicating the current trend of search. The term “antimicrobial activity” suggests the investigation of this biological activity for the species (2 occurrences, 12 links). The term “essential oil” (6 occurrences, 17 links) linked to these activities may indicate that the essential oil was used for the research of antioxidant and antimicrobial activity.

**Figure 11 - Scientometric mapping of keywords co-occurrences – *C. pubescens***

Source: Authors.

3.2.4 *Campomanesia phaea* (O.Berg) Landrum

*C. phaea* is an endemic species native to Brazil, found in temperate and semi-temperate zones in the states of São Paulo and Rio de Janeiro, currently classified as vulnerable to extinction risk by the World Conservation Monitoring Center (1998). According to the Tropical Plants Database (2021), it is a species rarely found in natura, being often cultivated, within its native distribution area, by local communities that appreciate the pleasant acid-astringent flavor of its fruits, known as “cambuci”,
which can be consumed fresh and in jellies and ice cream. It is a semideciduous tree with a naturally scaly trunk that can grow from 4 to 9 m in height with thin, overhanging branches. It is a plant used for heterogeneous reforestation of preserved and protected areas and wood is also used in general carpentry and agricultural implements. The traditional use of the plant in cardiovascular disorders has been investigated (Wczassek et al., 2020), as well as its action potential as an antioxidant (Castelucci et al., 2020) and metabolic disorders (Donado-Pestana et al., 2015, 2021).

3.2.4.1 C. phaea – Análises Bibliométricas

The search for C. phaea in WoS yielded 25 results, with 23 articles, 1 review article and 1 news document. The most productive years were 2021, 2020 and 2017 with 7 (28%), 5 (20%) and 3 (12%) publications respectively. The author who contributed the most, with 4 of the 25 publications, was Jacomino, AP of the University of São Paulo (USP), who has so far produced 72 publications, 10% of them as first author, H-Index 14 and his area of research is fruit growing. The USP institution led the affiliation ranking with 17 (68%) of the publications. The geographic distribution of the species in the state of São Paulo may have motivated this greater interest in C. phaea. Each of the 25 publications is in different 25 journals, most of them related to agriculture, nutrition and plant science (Agronomy Basel, Caryology, Food Chemistry, among others). As well as the main area of research on the plant was Food Science Technology (8/25 = 32%); Agriculture and Plant Sciences with 7 publications each (28%).

3.2.4.2 C. phaea – Co-occurrence network analysis by keywords

The analysis of the occurrence of keywords in the VOS, represented by Figure 12, limited the minimum number of occurrences to 2, resulting in 170 words, grouped into 29 items, 4 clusters, 146 links and 186 the total strength of the link. linking the terms reinforces the food interest aroused by the fruits of this Brazilian species, known as “cambuci” (5 occurrences, 21 links). Cluster 2, in lilac, which are to the left of the bar, suggests that the first researches have investigated the presence of phenolic compounds, a term that appears with 4 occurrences and 13 links, also linked to the words polyphenols and ellagic acid (both with 2 occurrences and 11 links) and a possible anti-oxidant activity for the cambuci fruit.

Figure 12 - Scientometric mapping of keywords co-occurrences – C. phaea.
3.2.5 *Campomanesia lineatifolia* Ruiz & Pav.

*C. lineatifolia* is an evergreen tree, which can grow from 5 to 10m in height. It is geographically distributed in the west range of South America, comprising the center and north of Brazil, Peru, Colombia and Ecuador. Its natural habitat is primary growth forests in non-flooded areas. Its fruits, harvested locally and consumed fresh or in the form of sweets, ice cream and jellies, are popularly known as “guabiraba” or “champa”. From the leaves, volatile compounds used in the manufacture of perfumes are extracted (Canteiro & Lucas, 2019; *The Plant List*, 2013).

### 3.2.5.1 C. lineatifolia – Análises Bibliométricas

Bibliometric analyzes in WoS indicate that the most productive years were 2009, 2012 and 2010 with respectively 5, 4 and 3 publications. Brazil was the country that published the most, although in a less hegemonic way compared to other species (12/21 = 57.1%). Colombia, a country that is also home to this species, comes in second with 8 out of 21 publications (38.1%). The most productive authors were Re-poppi N. (7/21 = 33.3%), Cardoso C.A.L. (5/21 = 23.8%) and Balaguera-lopes H.E. (4/21 = 19.0%). The first 2 authors did not research specifically on the species, these species being mentioned only in the Keywords Plus, but the 4 publications by Balaguera-lopes HE, affiliated researcher at the Universidad Nacional de Colombia, with a total of 20 publications and Híndex 4, are specifically about the species, as its name appears in the title of the 4 publications. The main areas of research were: Chemistry (9/21 = 42.9%); Food Science Technology (7/21 = 33.3%); Agriculture (6/21 = 28.6%); Pharmacology Pharmacy and Plant Science (both with 3/21 = 14.3%).

### 3.2.5.2 *C. lineatifolia* – Co-occurrence network analysis by keywords

The VOS analyzes in the *Campomanesia lineatifolia* species database, limited to 2 occurrences per word, out of 108 words, resulted in 19 items linked in a network, divided into 5 clusters, 77 links and 183 the total strength of the link. Figure 13 represents the network of keyword co-occurrence links, highlighting the terms Myrtaceae (which represents the family) linked to other species of the genus *Campomanesia*, *xanthocarpa* (8 occurrences, 12 links), *adamantium* (3 occurrences , 7 links) and *sessiflora* (2 occurrences, 6 links), suggesting that they were searched together. The term “essential oil” (9 occurrences, 16 links) linked to terms that denote chemical composition such as “beta triketones” (in lilac), “champane” and cryptomeridiol (in green), show the evolution of substances found in the composition of the oil. essential oil of the plant. The group of β-triketonos, among which the champanones, the main constituent of the volatile compounds of Champa and one of the most responsible for the intense and pleasant odor, are rare structures in compounds of natural origin and can be found in other species of Myrtaceae, especially of the genus *Eucalyptus*, *Kunzea* and *Leptospermum*. Champanones A, B and C, are yellow pigments found in champseeds, to which antimicrobial, anthelmintic and insecticidal activities have been attributed. There are commercially synthetic β-triketonos used as herbicide and due to the considerable presence of these compounds in C. lineatifolia, studies report a potential use of the species as an insect repellent (Bonilla *et al.*, 2005; Osorio *et al.*, 2006).
3.2.6 Campomanesia guazumifolia (Cambess.) O.Berg

C. guazumifolia is a native species, not endemic to Brazil, with phytogeographic domain Cerrado, Atlantic Forest and Pampa, geographically distributed in the following South American countries: Argentina, Paraguay and Brazil. In Brazil, it has been confirmed in the Northeast (Bahia), Midwest (Mato Grosso do Sul), Southeast (Espírito Santo, São Paulo, Minas Gerais and Rio de Janeiro) and South (Paraná, Rio Grande do Sul and Santa Catarina) regions. Popularly known as “Sete-capotes”, because of the layers of cork-like bark that naturally detach from the trunk in layers (capotes or capes). It is a deciduous tree with an open crown that can grow from 3 to 8 m in height. The fruits, although edible, are not unanimous in approving the sweet-sour flavor (Oliveira; Costa & Proença, 2020). It is popularly used in the treatment of liver disorders (Dorigoni et al., 2001) and diarrhea (Brandão, 1991).

3.2.6.1 C. guazumifolia – Análises Bibliométricas

The first study involving C. guazumifolia indexed in WoS, dated 2001 and investigated the chemical composition of the essential oil of some species of Campomanesia. In C. guazumifolia, the main constituents found were Spathulenol (27.7%) and 1β-caryophyllene oxide (29%) (Limberger et al., 2001). The second WoS publication came in 2013 and sought to understand the leaf and stem morphoanatomy of the species and indicated the presence of calcium oxalate and phenolic compounds in the leaves and also in the stem (Arruda et al., 2013). In 2018, there were 2 publications, one of which sought to morphologically characterize the development of fruits, seeds and seedlings, aiming at the commercial production of seedlings (Souza et al., 2018). The other study from 2018 investigated the anti-inflammatory activity and toxicological profile of the infusion of leaves in mice, in which anti-inflammatory potential with low toxicity was evidenced (Catelan et al., 2018). In 2019, there were 3 publications. For the first time, antioxidant and antimicrobial potential of C. guazumifolia essential oil were reported and the main compounds identified by GCxGC/qMS were bicyclogermacrene (15%), globulol (5%) and spathulenol (5%). Sesquiterpene hydrocarbons (29 compounds) and oxygenated sesquiterpenes (20 compounds) were the most representative class of terpenes (Santos et al., 2019). Another 2019 study investigated the infestation of fruit fly species infesting C. guazumifolia fruits (Almeida
et al., 2019). The third study from 2019 reported an increase in Sun Protection Factor (SPF) in formulations containing Octyl Methoxycinnamate in association with Campomanesia extracts (C. guazumifolia, C. sessiliflora, C. xanthocarpa and C. adamantium) alone or in association. All combinations were effective in increasing the SPF, and the combination of C. xanthocarpa and C. adamantium obtained higher SPF rates (Catelan et al., 2019). Until October 2021, there were 3 publications and none of them with potential clinical application. One of them dealt with the morphoanatomical differences of parts of the ovary and pericarp of some species of Campomanesia native to Brazil (Pittarelli et al., 2021). Another study investigated the viability of this species and sought to elucidate aspects of pollen germination (Guollo et al., 2021) and the third proposed an alternative for the treatment of effluents in the pharmaceutical industry that produces ketoprofen, using acid-treated “sete-capotes” tree bark sulfuric acid (Preigschadt et al., 2021).

3.2.6.2 C. guazumifolia – Co-occurrence network analysis by keywords

As there are only 10 publications about C. guazumifolia, all 87 words were considered for keyword co-occurrence analysis, which resulted in 72 items, 7 clusters, 436 links and 439 the total strength of the link. In Figure 14, which schematically presents these keyword co-occurrence relationships, it can be seen that in cluster 4, in dark blue, representing terms that appear in the first publications on the species, the words (e)-nerolidol, alpha-pinene, byciclogermacrene, globulol, linalool, spathulenol may indicate chemical composition studies. Terms indicative of biological activities such as “antioxidant activity”, “solar protection factor”, “cytotoxic activities” and “biological activity” in colors ranging from yellowish-green to yellow suggest research trends for these approaches. The xanthocarpa species appears in 2 occurrences, suggesting that they were investigated simultaneously.

Figure 14 - Scientometric mapping of keywords co-occurrences – C. guazumifolia.

Source: Authors.

4. Final Considerations

The analyzes of publications indexed in WoS, using bibliometric and scientometric mapping tools, suggest a growing interest in herbal medicines and medicinal plants native to Brazil with potential pharmacological applicability, without losing focus on sustainability and better use of our rich biodiversity, opening up thus a vast field of research that can investigate biological activities for species of the Campomanesia. New studies involving native Brazilian plants are welcome, so that they
can both support their traditional use by communities and to open up new possibilities for identification and isolation of compounds for research on new drugs.

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