Langgar: Journal of Social, Humanities, and Islamic Study
Vol.1, No.1 (2022), pp. 32-44

The Visualization of Stevia Research Trends Indexed by Scopus

Visualisasi Tren Riset Stevia Terindeks Scopus

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Abstract

The importance of this study is to visualize the stevia research trends that indexed by Scopus. This article focused on access availabilities, publication years, citation trends, author productivities, author affiliations, origin of countries/territories, subject areas, author collaborations, title terms, abstract terms, and author keywords. Scopus were search to find articles published up to April, 2022. VOSviewer were used to visualized the stevia research trends. 2917 articles was found using stevia keyword. Through title search, 1827 articles finally used in this research. There are 528 articles available on open access journals. The first article written in 1967 while the most recent written in 2022. The citation until 2022 was 28535 citations. The most productive author is Prakash, I with 24 articles. There are 46 author that affiliated with Institute of Himalayan Bioresource Technology India while most of the articles written by author from India. The most subject areas that used is agricultural and biological sciences. The cluster of author collaborations are 5 cluster while title terms are 10 clusters, abstrac terms are 5 clusters, and author keywords are 7 clusters.

Keywords: *stevia; research trends; visualization; VOSviewer; Scopus*

Abstrak

Artikel ini membahas tentang visualisasi tren penelitian stevia yang terindeks Scopus. Visualisasi tersebut dilakukan untuk memberikan gambaran mengenai bagaimana tren penelitian stevia di dunia internasional. Agar pembahasan dalam artikel dapat dipahami dengan baik, maka pembahasan dalam artikel ini difokuskan pada ketersediaan akses, tahun terbit, tren sitasi, produktivitas penulis, area subjek, afiliasi penulis, kolaborasi, istilah yang digunakan dalam judul, abstrak, dan kata kunci oleh penulis. Data diperoleh melalui pencarian pada situs Scopus menggunakan kata kunci pencarian stevia. Hal tersebut dilakukan untuk memperoleh artikel yang terbit dan terindeks Scopus sampai dengan bulan April 2022. Hasil penelusuran kemudian diolah menggunakan VOSviewer untuk memvisualisasi tren penelitian stevia yang telah ditemukan. Sebanyak 2917 artikel ditemukan berdasarkan penelusuran sederhana. Selanjutnya, dilakukan pembatasan penelusuran hanya pada judul artikel menggunakan kata kunci yang sama diperoleh 1827 artikel dan selanjutnya digunakan dalam penelitian. Berdasarkan ketersediaan akses, terdapat 528 artikel tersedia dalam bentuk *open access*. Artikel pertama ditulis pada tahun 1967, sedangkan artikel terbaru ditulis pada tahun 2022. Hasil penelitian tentang stevia yang diterbitkan telah banyak disitasi oleh penulis lain, yaitu sebanyak 28535 sitasi. Penulis paling produktif adalah Prakash, I. Kebanyakan penulis terafiliasi dengan *Institute of Himalayan Bioresource Technology India*. Sedangkan berdasarkan negara/wilayah teritori, kebanyakan penulis paling banyak berasal dari India. Area subjek yang

paling banyak digunakan adalah *agricultural and biological sciences*. Analisis menggunakan VOSviewer menghasilkan 5 kluster kolaborasi penulis, 10 kluster istilah judul, 5 kluster istilah abstrak, dan 7 kluster kata kunci oleh penulis.

Kata Kunci: *stevia; tren penelitian, visualisasi, VOSviewer, Scopus*

Introduction

The Covid-19 pandemic has had a tremendous impact on the lives of the Indonesian people. One of the closely related to the pandemic is health problems. For example, based on 2021 data, there has been a significant increase in diabetes cases during the two years since the pandemic occurred. The number of people with diabetes in Indonesia from 2019 to 2021 has increased by 9 million people (Dinisari 2021).

One of the causes of the increasing number of people with diabetes is the habit of consuming excess sugar. Although it is not a direct cause, people who consume sugar in excess have a higher risk of developing diabetes (P2PTM Kemenkes RI 2019). As a form of prevention, people need to regulate sugar consumption to avoid diabetes. One of the recommendations is to consume low-calorie artificial sweeteners as a substitute for the consumption of sweeteners from sugar (Rianto, Handoko, and Novianry 2018).

Currently, there are many low-calorie artificial sweeteners on the market. These various products result from processed natural ingredients, one of which is stevia, a herbaceous plant originating from Paraguay (Rahmawati, Asmono, and Sjamsijah 2020). As a substitute for sugar, stevia has a sweetness level of 250-300 times sweeter than sucrose (Widodo, Munawaroh, and Indratiningsih 2015).

There is a lot of previous research on stevia. More than 500 studies on stevia have been carried out (Raini and Isnawati 2011). However, until this article was written, the author had not found a bibliometric analysis of the various studies that have been produced. This analysis is essential as a form of control over existing research results. The number of stevia studies needs to be controlled to avoid duplication of research. The type of control that can be done is visualizing stevia research trends using VOSviewer.

This study aims to examine and visualize the research trend of Scopus indexed stevia. The research questions that focus on this article are how stevia research trends are based on access availability, year of publication, citation trends, author productivity, subject area, author affiliation, collaboration, terms used in the title, abstract, and keywords by the author. The results of this study are expected to provide an overview in the form of visualization of trends in the results of research on stevia indexed by Scopus.

Theoretical Framework

Many previous researchers have researched stevia. The author's search results on the Garuda portal resulted in 176 research documents published in the form of

journal articles and proceedings. Meanwhile, in Neliti one of the scientific repositories in Indonesia, 42 research results have been found related to stevia.

One of the studies related to stevia that previous researchers have done is that conducted by Zulhamdi. In 2020, Zulhamdi wrote an article related to the feasibility of the stevia business at a company in Indonesia. The results show that the opportunities and demand for stevia products are very wide open. According to him, the stevia plant is also feasible to develop on a plantation scale (Zulhamdi 2020).

Sumanto and Sembiring carried out subsequent research. They both researched the effect of growing media on the growth of stevia cuttings. The results showed that a mixture of humus soil and litter compost with a ratio of 1:1 was a suitable planting medium for shoot cuttings of stevia plants (Sumanto and Sembring 2021).

The third research is by Yokubjonovich, one of the researchers at the Scientific Research Institute of Seed Production and Cultivation Agrotechnologies of Cotton Breeding. Through a study published in 2022, Yokubjonovich studied the effect of sowing date and seedling thickness on the leaves produced by Stevia plants. The results showed that April is the recommended time for sowing seeds with a seed density of 111,000/ha (Yokubjonovich 2022).

Umami and Afifah conducted the fourth study. In 2015, they conducted research on stevia and sappan wood in yogurt as an alternative drink for people with diabetes. The results showed that the antioxidants in the yogurt drink added with secang wood and stevia were 36.57%. While the sugar content produced is 4.94%. According to the panelists, the addition of sappan wood extract content of 0.25% and stevia leaf extract of 0.25% in yogurt was the most preferred composition (Umami and Afifah 2015).

Various searches that the author has carried out show that studies related to visualization of stevia research results have not been carried out, mainly because studies related to visualization of research results are the bibliometric field. Visualizing research results is mapping the topics studied in a research field.

Bibliometrics is a research method used to examine intellectual structures (Kaid 2018). Pritchard first introduced this method in 1969 (Ahmi 2021). One form of activity in this method is to map the topics of research results in specific fields.

To make the deep mapping process more manageable, some researchers in the bibliometric study use computer applications, such as VOSviewer. The utilization of VOSviewer in the bibliometric analysis is to facilitate the visualization process. This application has several advantages, namely text mining and integrated clustering in the analysis process (Van Eck dan Waltman dalam Tupan and Rachmawati 2017).

Research Method

This research is quantitative research with the bibliometric method. Data is collected through several stages. The first is determining the keywords to be used. The keyword

used in the article search process is 'stevia.' The selection of these keywords is based on considering the suitability of the research topic to be searched. Furthermore, after the researcher determined the keywords, the researcher searched the Scopus database. Free search results using the keyword 'stevia' yielded 2917 articles. The next step is to make an article selection. Article selection is by limiting the search to only the title field. The selection results found as many as 1827 articles with titles containing the word 'stevia'. Furthermore, the selected article data is then exported into a Research Information System (RIS) document format to be analyzed using VOSviewer.

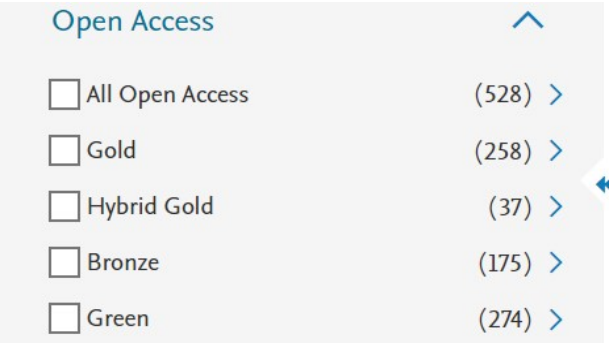
Research Results

1. Access Availability

Scopus indexed journal articles are generally available in closed access and open access forms. Closed access refers to journal articles that are not freely accessible (Mafar 2021). People who want to access closed access articles must subscribe or pay first. Meanwhile, open access refers to available journal articles that people can access freely without paying or subscribing in advance. Journal articles with open access types are divided into three categories: gold, hybrid, and green. Gold refers to articles published in open access journals. Hybrid refers to articles published in journals with an open access option for authors (authors can choose whether the article will be available in open access or closed access).

In comparison, green refers to published manuscripts stored in the repository. Along with the development of published articles, a new category emerged in open access journals, namely bronze which refers to copyrighted articles. Still, the publishers decided to give open access rights to readers, either permanently or temporarily (Valsiner 2019). The search results show that there are 528 articles available in open access form. While the rest, as many as 1299 other articles, are available in closed access form.

Figure 1. Availability of articles in the open access category



Source: *scopus.com*

2. Publication Years

Based on the year of publication, the first Scopus indexed stevia research article was published in 1967. In the following years, researchers carried out most research on stevia in 2021 with 182 articles *GlucoMedix®, an extract of Stevia rebaudiana and Uncaria tomentosa, reduces hyperglycemia, hyperlipidemia, and hypertension in rat models without toxicity: a treatment for metabolic syndrome* was written and published in 2022.

Table 1. Number of articles by publication years

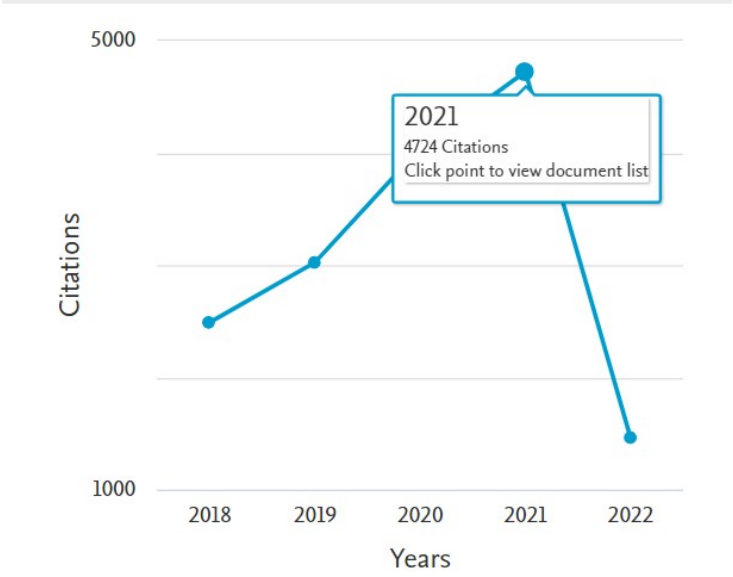
Years	Article Numbers
2022	47
2021	182
2020	152
2019	168
2018	147
2017	136
2016	121
2015	102
2014	119
2013	93
1967-2012	560

Source: *scopus.com*

3. Citation Analysis

Citation analysis is one of the techniques for measuring the quality of scientific work. The higher the citation level of an article, the higher the quality of the article is indicated. There were 28535 citations made to scopus indexed stevia articles. The results of the citation analysis on the stevia article show that the most citations were found in 2021 as many as 4724 citations.

Figure 2. Number of citations



Sumber: *scopus.com*

4. Author Productivity

One hundred sixty authors produce Scopus indexed stevia research articles. Each author makes a different number of articles. The most prolific writer is Prakash, I with a total of 24 articles produced.

Table 2. Top 10 Author

Author Name	Articles
Prakash, I	24
Angelini, L.G.	18
Chaturvedula, V.S.P	18
Tavarini, S.	18
Ahmad, N.	16
Cerda-Garcia-Rojas, C.M.	16
Geuns, J.M.C.	15
Kahrizi, D.	15
Yang, Y.	15
Herz, W.	14

Source: *scopus.com*

5. Author Affiliations

The authors of the stevia research articles come from a variety of different affiliations. Institute of Himalayan Bioresource Technology India is the most author affiliate with 46 authors. Other institutions to which the author is affiliated (top 10) are Universidade Estadual de Maringa, Chinese Academy of Science, Instituto Politécnico Nacional, Centro the Investigacion y de Estudios Avanzados, Università di Pisa, the Coca-Cola Company, Consejo Nacional de Investigaciones Cientìficas y Téchnicas , Universitat de València, Universidad Autónoma de Yucatá.

Table 3. Top 10 affiliations

Affiliations	Articles
Institute of Himalayan Bioresource Technology	46
Universidade Estadual de Maringa	44
Chinese Academy of Science	35
Instituto Politécnico Nacional	34
Centro the Investigacion y de Estudios Avanzados	26
Università di Pisa	26
the Coca-Cola Company	23
Consejo Nacional de Investigaciones Cientìficas y Téchnicas	22
Universitat de València,	21
Universidad Autónoma de Yucatá	20

Source: *scopus.com*

6. Country of Origin

Like the author's affiliation, stevia research articles are produced from various countries. The country that has the most articles is India, with a total of 288 articles. Next, in order (top 10), the articles produced are from America, China, Brazil, Mexico, Iran, Spain, Japan, Italy, and Germany.

Table 4. Top 10 Countrie

Countries	Articles
India	288
United Stated of America	153
China	140

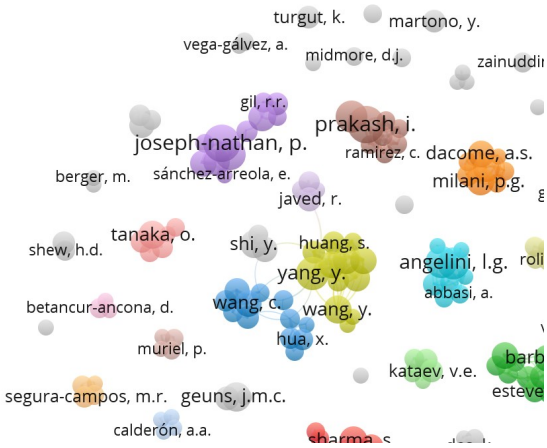
Brazil	120
Mexico	119
Iran	117
Spain	88
Japan	80
Italy	74
Germany	59

Source: *scopus.com*

7. Author Collaboration

The collaboration of the author in research is a natural thing to find. Several researchers collaborate on one research title to meet the required expertise based on the research theme. In addition, collaboration can also show the level of difficulty of a research field (Rahayu and Rachmawati 2015). By limiting the maximum number of authors in one document to 25 and the minimum number of documents for one author to 5 documents, 211 authors have a collaboration network that is divided into 55 clusters. The author with the highest number of links is Yang, Y., with 40 documents and 86 links.

Figure 3. Author Collaboration



Source: VOSviewer

8. Subject Area

Scopus indexed stevia research articles cover a wide range of subjects. There are 26 subject areas in the stevia study. The most significant subjects are agriculture and biological sciences with 1085 documents, biochemistry, genetics and molecular biology with 558 documents, and chemistry with 328 documents.

Table 5. Top 10 Subject Areas

Subject Areas	Articles
Agricultural and biological sciences	1085
biochemistry, genetics and molecular biology	558
Chemistry	328
Pharmacology, toxicology and pharmaceutics	282
Medicine	226
Chemical engineering	112
Environmental science	109
Immunology and microbiology	87
Nursing	66
Materials science	44

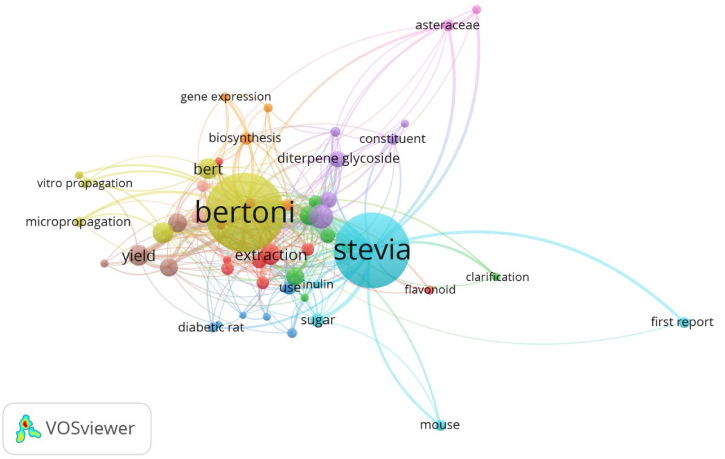
Source: *scopus.com*

9. Title Term Tren

The researcher conducted a title trend analysis to measure the number of terms that appear simultaneously in the article's title under study. By limiting the minimum number of terms appearing ten times, 53 terms appear with a relevance level of 60%. A total of 10 term clusters were found. The first cluster contains 10 terms, the second and third clusters have 7 terms, the fourth and fifth clusters have 6 terms each, clusters 7 and 8 have 4 terms each, and clusters 8 and 10 have 2 terms each. 2 terms are most often used in the title, namely stevia and bertoni.

Stevia is a general term used to describe herbaceous plants with the Latin name stevia rebaudiana. The term stevia has a link strength level of 309. In comparison, bertoni is the name of the inventor of stevia named Moisés Santiago Bertoni. A chemist from Paraguay discovered the stevia plant in 1903 (Fitriyani 2014). The term bertoni has a link strength level of 391.

Figur 4. Title term visualization



Source: VOSviewer

10. Abstract Term

Similar to the trend analysis of the title term, the analysis of the trend of the terms appearing in the abstract is done by limiting the minimum number of occurrences of the term to 10 times. Five hundred twenty-three terms appear with a relevance level of 60%. There are 5 clusters of terms found in the abstract of stevia research articles. The first cluster contains 237 terms, the second cluster contains 115 terms, the third cluster contains 83 terms, the fourth cluster contains 64 terms, and the fifth cluster includes 24 terms.

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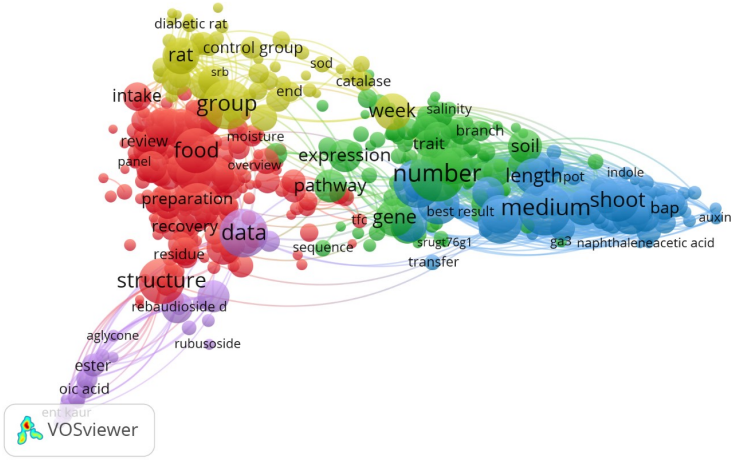
Figure 5. Abstract term visualization



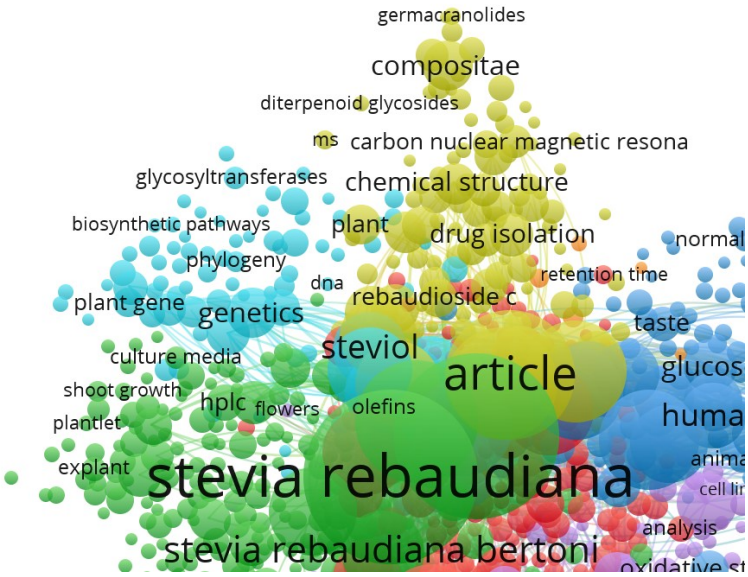
Source: VOSviewer

11. Keyword by Authors

Each Scopus indexed research article has keywords created by the authors. The keyword analysis made by the article authors can describe what terms can be used as keywords in a Scopus search. The analysis results with a minimum limit of the occurrence of keyword terms as much as 5 times obtained 9690 keywords with 991 related keyword terms.

There are 7 keyword clusters found. The first cluster contains 249 terms, the second cluster contains 241 terms, the third cluster contains 210 terms, the fourth cluster contains 97 terms, the fifth cluster contains 93 terms, the sixth cluster contains 86 terms, and the seventh cluster includes 15 terms. The term most often used as a keyword by the author is stevia rebaudiana. This term is the Latin name for the stevia plant. This means that the highly recommended search keyword in the search for research articles about stevia is stevia rebaudiana.

Figure 6. Keyword by authors



Source: VOSviewer

Conclusion

Based on the results and discussion above, there are 528 stevia research articles available in open access form. The first article was written in 1967, while the latest article was written in 2022. The research results on stevia published have been widely cited by other authors, with as many as 28535 citations. The most prolific writer is Prakash, I. Most of the authors are affiliated with India's Institute of Himalayan Bioresource Technology.

Meanwhile, based on country/territory, most of the writers are mainly from India. The most widely used subject areas are agricultural and biological sciences. Analysis using VOSviewer resulted in 5 clusters of author collaboration, 10 clusters of title terms, 5 clusters of abstract terms, and 7 clusters of keywords by authors.

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