Research Article

Bibliometric Analysis of Global Research Trends on Plant Extract in Antidiabetic Research

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ABSTRACT

Natural products have been found to have antidiabetic effects in a growing number of studies, making them a popular topic in antidiabetic research. This paper sought to examine the present state of plant extract research and provide emerging trends in the field through bibliometric analysis based on publication outputs, co-authorships between authors and affiliated nations, and co-occurrences of author keywords. Research papers on natural remedies for diabetes were taken from the Scopus core collection database. The studies were analyzed and plotted using VOSviewer. According to the results, there has been a consistent rise in the total number of publications since 2008, with an increase of 50 articles every two years. This pattern has continued to this day. The findings of this investigation indicate that 2190 records of plant extract in antidiabetic research were published between 1989 and 2022. Researchers in India accounted for over 30% of all publications published worldwide. Additionally, the next two of the most productive countries were Nigeria and Indonesia. In conclusion, recent advancements in plant extract related to antidiabetic research encompass the following: (i) phytochemical investigations with high liquid chromatography (HPLC) coupled with mass spectrometry (MS) to define the metabolite profiling of plant extracts; (ii) molecular docking concerning phytochemicals, antioxidants, and antidiabetics; and (iii) biological and antidiabetic activities of green synthesis incorporating zinc oxide nanoparticles.

Keywords: plant extract, antidiabetic, bibliometric, VOSviewer

1.   INTRODUCTION

Diabetes mellitus is recorded as rapidly growing worldwide. According to the World Health Organization (WHO), diabetes mellitus has become one of the leading causes of failure in various body organs, even death (Lin et al., 2020). Diabetes mellitus of all types has grown exponentially in recent decades worldwide and is expected to reach 629 million in 2045 (Glovaci et al., 2019; Khan et al., 2020). The healthcare sector is currently concerned about the condition of diabetes (Lin et al., 2020). The cost of treating primary diabetes mellitus and its

complications with contemporary medications is still high (Hidayat et al., 2022). Due to the soaring costs of managing diabetes and its complications, there is an urgent need for alternative treatments that are safer, more efficient, and more affordable (Lankatillake et al., 2019). There are many complications because of diabetes mellitus (Reddy & Tan, 2020). Low peripheral glucose disposal and excessive hepatic glucose production are the main causes of diabetic hyperglycemia, which in turn results in microvascular and macrovascular problems such as retinopathy, neuropathy, nephropathy, cardiovascular disease, stroke, and amputations (Sharabi et al., 2015). Due to the nature of their mechanisms of action, the therapeutic medicines currently used to treat these issues, like acarbose, voglibose, and miglitol are linked to gastrointestinal side effects such as nausea, constipation, and diarrhea. Hence, future diabetes mellitus management will require alternative agents with fewer side effects, for instance, natural products made from plants and microbes (Borse et al., 2021). Additionally, the rise in diabetes cases necessitates the creation of innovative and practical therapeutic approaches. Identification of the most influential authors, important subjects, and frequently used keywords is crucial given the quick growth of natural products in antidiabetic research. Emerging patterns in the creation of pertinent knowledge should also be examined.

Natural products have been identified as one of the primary possible sources of medication development resulting from extensive research into the screening of antidiabetic medicines in recent decades. A lot of research has been done on using natural items as diabetes treatments. More than 400 plant species are reported to treat diabetes, and this is an essential and promising source for the identification of new antidiabetic compounds (Tran et al., 2020). However, only a small number of plant-based medications have received scientific validation. Therefore, there is much interest in developing new diabetes medication (Jugran et al., 2021). Thus, natural compounds can be investigated as prospective diabetes medications. Bibliometric analysis has been extensively utilized in several research domains to quantify literature evaluation and uncover emerging trends. An analysis based on bibliographic data and publication outputs will be processed for bibliometric mapping to visualize research trends and research networks (Charlina et al., 2021; Kartikowati et al., 2021). However, there hasn't been a thorough, systematic evaluation and bibliometric study of natural products or plant extracts in antidiabetic studies. Therefore, the goal of this study was to use bibliometric methods to visualize the references with vivid information to better understand the current situation and trends of natural products in antidiabetic research. A bibliometric analysis study is a mechanistic way of evaluating worldwide research trends in a particular field based on the outputs of the academic literature database. A review paper, which is primarily designed to examine the most recent advancements, difficulties, and potential future directions of a certain issue, differs from a bibliometric analysis study in that it uses a different method (Donthu et al., 2021). The largest abstract and citation database for peer-reviewed literature on a variety of topics is known as Scopus. To cover more ground in antidiabetic research, Scopus is being used. The goal of this bibliometric study was to assess the global research trends in plant extracts in antidiabetic research fields based on publication outputs, co-authorships between authors and affiliated nations, and co-occurrences of author keywords. According to this paper, understanding the study trends in plant extracts for antidiabetic research and the potential for future studies will be helpful for researchers, policymakers, and individuals.

2. METHODOLOGY

2.1. *Data Source and Search Strategy*

Data mining was conducted by using the Scopus database. Research articles that included "plant extract especially leaf extract in antidiabetic research" in the title and abstract were

included in this investigation. The oldest article was published in 1989, and the most current ones are from 2023. The search was carried out using a query string with the keywords leaves, extract, and antidiabetic in the period 1989–2022. This query string resulted in 2190 documents. To ensure no review articles were included in our analysis, additional query strings were added and articles were in English only, which resulted in 395 articles being excluded for further analyses. The total number of document findings in the final data sources was 1795. The abstract and author keywords from the document results, along with the citation and bibliographical data, were exported into a CSV file for additional analysis (Farias et al., 2022). Figure 1 is a summary of the data mining and report removal procedures.
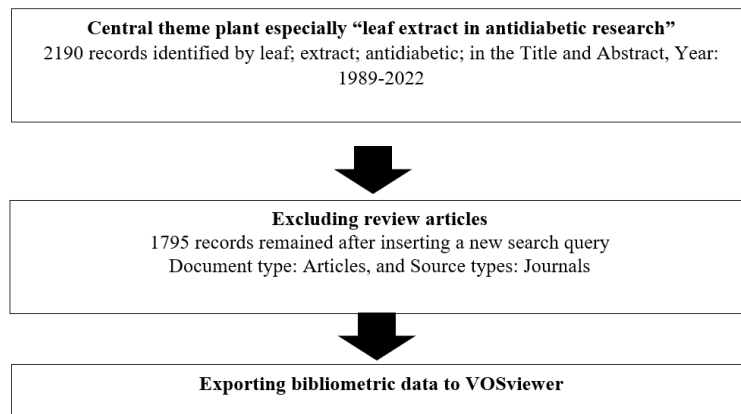

Figure 1. Data mining and report elimination for obtaining bibliometric information

2.2. *The Maps of Bibliometric*

The citation, bibliographical, and author keyword data from 1795 articles were exported to VOSviewer (version 1.6.19, Centre for Science and Technology Studies, Leiden University, The Netherlands) to construct and display bibliometric maps. Countries or author keywords are included in maps made with VOSviewer as objects of interest. Any two pairs of items may have a link, also known as a connection or relationship between the two items. Each link's strength is represented by a positive numerical value. This value is higher the closer the connection (Wiyono et al., 2022). In a co-authorship analysis, the link strength between two related nations indicates how many publications they have co-authored. In contrast, the overall link strength indicates how many publications all affiliated nations have co-authored. Similar to how co-occurrence analysis works, the link strength between author keywords shows how frequently two keywords appear together in publications. In addition, additional data analysis was carried out using Microsoft Excel 365 (Donthu et al., 2021; Seo et al., 2022).

2.2.1. *Analysis of Bibliographic Data*

The information collected from the search term was further examined for pertinent subject areas, the most productive journals, nations, and institutions, as well as the identification of prolific authors. The top-producing journals were found by filtering the document results based on the "source title." Meanwhile, the 'Analyze search results' tool was used to examine similar subject areas, the most productive nations, and writers (Seo et al., 2022).

2.2.2. *Analysis of Countries' Co-Authorship*

The analysis of countries' co-authorship covered a total of 95 nations. The analyses were carried out using the exported data file, and a minimum of one publication per nation was established for each analysis. A line connecting two countries denotes their relationship, while

the number of articles they have jointly written is represented by the link strength (Shen et al., 2021).

2.2.3. *Analysis of Keyword Co-Occurrence*

The co-occurrence of author keywords was examined using Vosviewer's analysis of the frequency with which author keywords appeared in the bibliographic data (Charlina et al., 2021; Kartikowati et al., 2021). Five keyword occurrences were established as the minimum by researchers. Then, in VOSviewer, the minimum number of occurrences of a term to be analyzed was set to five. To examine the average publication year, frequency, and link strength of the keywords, an overlay visualization style was used. The color of a term denotes the typical publishing year of the texts where it appears.

3.   RESULTS AND DISCUSSION

In the first round of keyword search results, Scopus discovered 2190 article papers. The period for identifying articles is unconstrained since the goal of this study is to track the general evolution of the plant extract in antidiabetic research subjects. According to our research, the first work on leaf extract subtheme in antidiabetic research was found in October 1989, as seen in Figure 2.

3.1.   *Research Development in the Field of Plant Extract in Antidiabetic Studies*

A worldwide increase in researchers is evident from the surge in scientific papers in the field of plant extracts in antidiabetic research (Figure 2).
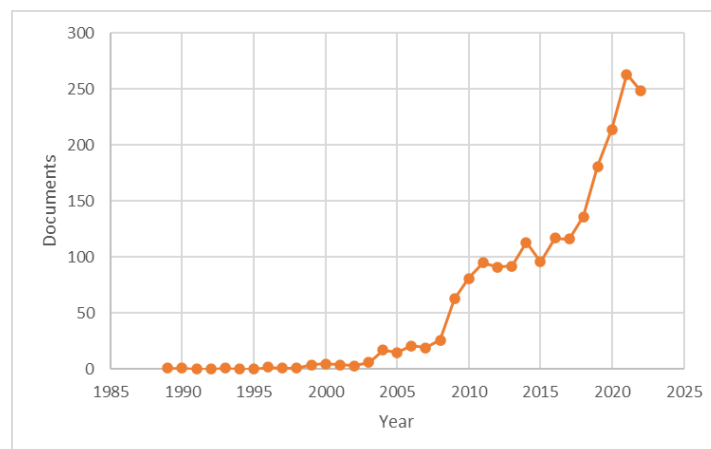

Figure 2. Trend research of plant extract and antidiabetic worldwide

From 1989 to 2001, there was no rise in plant extract for antidiabetic research. The peak accelerated from 2016 to 2021. The most significant increase happened in 2021 (263 documents). Due to the limited community activities in many nations and the potential link to the COVID-19 outbreak that swept the globe in 2020, it is imperative to prepare for alternative treatments derived from natural sources.

3.2.   *The Most Prolific Writers in the Publication of Research on Plant Extracts for Diabetes*

The top ten authors of works that were published in Scopus journals are shown in Table 1. The author on the list with the most publications, Orhan (publications from 2006 until 2021), has penned about fourteen papers. Asmawi (publications from 2011 until 2022) has authored

thirteen publications, followed by Islam (eleven publications). Aslan and Kumar have ten publications. Chigurupati, Elya, Mumtaz, Pari, and Ramkumar have each written nine papers.

Table 1. Top ten authors contributing to studies on plant extracts and diabetes

Rank	Author	Documents	Institution
1	Orhan	14	Gazi Üniversitesi
2	Asmawi	13	Universiti Sains Malaysia
3	Islam	11	King Saud University
4	Aslan	10	Harran Üniversitesi
5	Kumar	10	Indira Gandhi University
6	Chigurupati	9	Qassim University
7	Elya	9	Universitas Indonesia
8	Mumtaz	9	University of Gujrat
9	Pari	9	Annamalai University
10	Ramkumar	9	SRM Institute of Science and Technology

3.3. *Analysis of Cooperation Network Relations between Countries and Institutions*

Over 33 years (1989–2022), Table 2 includes the top ten producing institutions that have published the most publications in the field of plant extracts in antidiabetic research.

Table 2. Top ten productive institutions related to the plant extract in antidiabetic research

Rank	Institution	Documents	Location
1	University of Nigeria	30	Nigeria
2	University of KwaZulu-Natal	27	South Africa
3	King Saud University	25	Saudi Arabia
4	Annamalai University	25	India
5	Universitas Indonesia	23	Indonesia
6	Universiti Sains Malaysia	22	Malaysia
7	Bharathiar University	22	India
8	Lembaga Ilmu Pengetahuan Indonesia	21	Indonesia
9	National Research Centre	20	Egypt
10	Universiti Putra Malaysia	20	Malaysia

3.4. *Ten Author Nations by Number of Publications*

India publishes the most about plant extract in antidiabetic research, with 737 documents (Figure 3), followed by Nigeria with 176 documents, Indonesia with 156 documents, and Malaysia with 111 documents. Pakistan, Saudi Arabia, South Africa, Brazil, Egypt, and China have under 100 documents for this research.
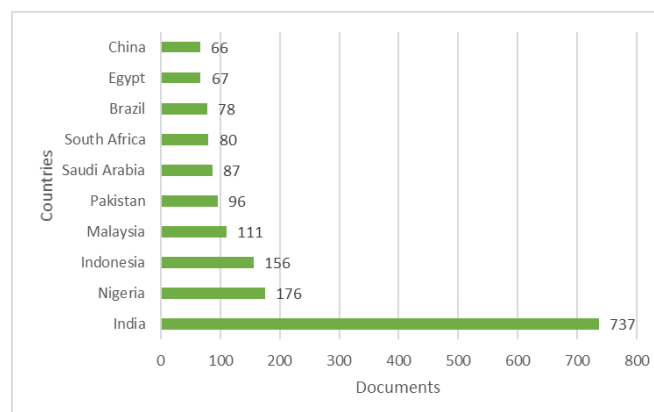

Figure 3. Top Ten Countries in the area of plant extract and antidiabetic research worldwide

3.5. *The Core Journal of Plant Extract in Antidiabetic Research*

Figure 4 lists the top ten peer-reviewed journals from 1989 to 2022 that have published the most publications in the field of plant extracts in antidiabetic studies. The Journal of Ethnopharmacology, which has 97 articles, is the journal with the greatest number of published publications. Then, studies in Molecules journal contributed to the publication of 41 documents, and the Asian Journal of Pharmaceutical And Clinical Research journal contributed to the publication of 38 papers.
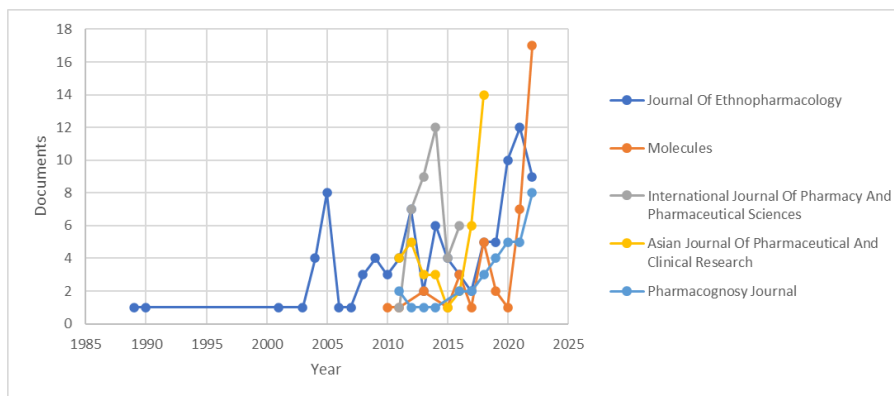

Figure 4. Top ten journals by documents per year

3.6. *Visualization of the Subject Area Using VOSviewer*

Vosviewer's default representation for terms related to a plant extract and research issues in the antidiabetic study was circles. The larger the circle, the more frequently an object or keyword appears (Meng et al., 2022). As shown in Figure 5, India has the biggest circle. Then, the color of VOSviewer shows the average publication year of the document in which a keyword occurs, showing India pays long attention to plant extracts in antidiabetic research. The most common study topic was antidiabetic as shown in Figure 6, since it is so prevalent. It indicates the increasing significance of the keyword. The frequency of the objects determines their magnitude. When the color is applied to the elements, each circle has a distinct color linked to its cluster (Jiménez-Almazán et al., 2020).

Vosviewer's analysis of the frequency of author keywords in the bibliographic data was used to generate the result. Five keyword occurrences were identified as the minimum by researchers. Then, out of the 3703 keywords we received, only 228 met the criteria. The intensity of the links between two keywords may also be used to determine the research interest in particular fields (Donthu et al., 2021). For instance, the phrases "toxicity," "antioxidant," and "molecular docking" were related to 67 additional terms by 67 linkages for the keyword "phytochemicals. The connection strengths, which were 12 and 2, respectively, suggest that the study focus on phytochemicals as antioxidants was greater than phytochemicals as toxins.

Recent developments in plant extract for antidiabetic research include the following, according to the network and overlay visualization of VOSviewer: (i) phytochemical investigations with high liquid chromatography (HPLC) coupled with mass spectrometry (MS) to define the metabolite profiling of plant extracts; (ii) molecular docking concerning phytochemicals, antioxidants, and antidiabetics; and (iii) biological and antidiabetic activities of green synthesis incorporating zinc oxide nanoparticles.

Figure 5. India is the country that has the most research papers on plant extract in antidiabetic research using the overlay visualization of VOSviewer.

Figure 6. The highlight of co-occurrence in Vosviewer. This is a screenshot of the bibliometric map that was produced using the network visualization style and the co-occurrence of author keywords.

4.   CONCLUSION

In-depth analysis of current developments in the application of plant extracts in antidiabetic research is given in this article. In this study that prioritizes academic excellence and actively studies natural products, India is quickly gaining popularity as a big country. Meanwhile, Nigeria continues to dominate this field, closely followed by Indonesia. This study was the first to use VOSviewer to perform a quantitative and visual analysis of 1795 kinds of literature on antidiabetic research for plant extract in the core set of the Scopus database. The research results of plant extract in antidiabetic research from 1989 to 2022 were displayed through publication quantity, keyword co-occurrence, cooperation network relationship between countries, and cooperation network relationship between institutions, hoping to provide a reference for scientific workers engaged in the research of antidiabetic. To sum up, the following are some current developments in plant extract research related to antidiabetes: (i) molecular docking with a focus on phytochemicals, antioxidants, and antidiabetics; (ii)

phytochemical studies using high liquid chromatography (HPLC) in conjunction with mass spectrometry (MS) to define the metabolite profiling of plant extracts; and (iii) biological and antidiabetic activities of green synthesis incorporating zinc oxide nanoparticles.

Declaration of Interest
The authors declare that there is no conflict of interest.

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