
BIBLIOMETRIC ANALYSIS AND VISUALIZATION: A DEVELOPMENT OF PATCHOULI (POGOSTEMON CABLIN) RELATED RESEARCH FROM 2013-2023

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Abstract: This study is related to patchouli plants (*Pogostemon Cablin*) as the main published variable. The purpose of this study was to examine the profile of original scientific articles and reviews on patchouli topics using bibliometric analysis. Scientific articles related to patchouli (*Pogostemon Cablin*) published between 2013-2023 taken from Scopus. The notes analyzed and extracted for the following research citation characteristics, including the distribution of author names, year of publication, country or region, journals, publicators using Microsoft Excel 2016, VOSviewer v.1.61 are used to create bibliometric diagrams. A total of 303 original scientific articles and reviews, published in Scopus peer reviewed journals were written by 1732 identified authors. The number of articles that have been published continues to increase from 2013 to 2023. The majority of scientific articles written in English 283, Chinese 14, Portuguese 2, Germany 1, Indonesia 1, Russia 1 and the unidentified 1. China is the most superior country in the number of scientific articles published, namely ($n = 116$, 34%), the second country is Indonesia with ($n = 76$, 22%) articles, the third country is India with ($n = 43$, 13%). The article that receives the largest number of citations is published in Chinese Medicine (United Kingdom) with 1650 per year. Visualization analysis based on the accuracy of words connected in titles and abstracts has revealed several research groups, the research groups are patchouli, pogostemon cablin, bent, patchouli alcohol, essential oil. This research contributes to providing a systematic picture related to productivity and visibility of research work by focusing on patchouli plants (*Pogostemon Cablin*), it is hoped that this study and its findings can be used to organize and prioritize subsequent studies related to patchouli plants (*Pogostemon Cablin*).

Keywords: Patchouli (*Pogostemon Cablin*), Bibliometric Analysis, Scopus, Citation Analysis, Scientometric.

INTRODUCTION

Looking at the development of the times related to commercial, medicinal and aromatic plants are now in great demand, coupled with climatic factors owned by each region in various countries (Das, 2015). The country of origin of *Pogostemon Cablin* or what can be called patchouli is from India, India is a country whose geographical location is included in the agro-climatic zone which has a variety of flora that can grow in India, besides that India also has a variety of fauna as well (Das, 2015). Countries overgrown with patchouli plants from Asia are widely cultivated in India, Indonesia, Malaysia, China, the Philippines, and Brazil (Wu et al., 2013). How to plant patchouli is very simple with easy care and does not require high attention (Das, 2015). Patchouli is also a medicinal and aromatic plant that has a high export value, which is classified as an annual plant (Das, 2015). Patchouli comes from the Tamil word Patchai (patch means green, ellai means leaf). In India famous by the names patchouli, panada, pacchathene, this plant is widely cultivated in Southeast Asia and began to be known by Europeans around 1844 (Das, 2015). Various kinds of essential plants have been cultivated and developed in various countries, especially in Asian countries to be used as oil, but patchouli is one of the best class essential oil producers that are processed by drying, then distilled with a distillation machine (Donelian, A., Carlson, L., Lopes, T., Machado, 2009) or hydrodistillation (Das, K., Gupta, N., Sekeroglu, 2011). The yield or oil content produced by patchouli plants has variations, generally 2.5-3.5% of dry leaves distilled by distillation machines, reddish-brown oil color and has a viscous texture (Wu, Y.G., Guo, Q.S., Zheng, 2008). The aroma released has a distinctive *camphoraceous* aroma that cannot be replaced with other oils or synthetic patchouli oils, so this is what causes patchouli oil in the aromatic or perfume market to increase and is used as a basic ingredient in the perfume industry

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(Ramachandra, K.M., Vasundhara, M., Farooqui, A.A., Srinivasaappa, 2002). Alcohol content or what is called *patchouli alcohol* which has compounds $C_{15}H_{26}$ And *norpatchoulanol* is a major chemical component that has a major role for strong and long-lasting aromas, aroma oils and other components such as caryophyllene, and cycloseychellenel are also present (Akhila, A., Nigam, 1984).

Many uses and benefits are obtained from patchouli as a basic ingredient in perfume and as a medicinal plant for aroma therapy, namely controlling stress (Hur MH, Song JA, Lee J, 2014), eliminates labor pain (Jones L, Othman M, Dowswell T, Alfirevic Z, Gates S, Newburn M, 2012), controlling hypertension (Hur MH, Lee MS, Kim C, 2012), reduces postoperative nausea (Hines S, Steels E, Chang A, 2012) and improve symptoms of dimensia (Forrester LT, Maayan N, Orrell M, Spector AE, Buchan LD, 2014), However, empirical evidence lacks to support the way these treatments go into therapeutic treatment (Maddocks-Jennings W, 2004). Therefore, it can clearly be implemented well and in large-scale randomized controlled trials to determine the level of efficacy of aroma therapy, so it is necessary to analyze the main article, author and explore research on the topical relationship of content in patchouli patchouli and can contribute to adding science in the scope of biodiversity.

Bibliometric analysis is a methodology that can function to investigate patterns in publications based on data cited from academic literature, historically bibliometric analysis has been used to explore the relationship between the academic world through citations of scientific articles and used as an insight provider related to the dissemination of findings in research (Koo, 2017). Software used bibliometric analysis helps in finding poliferation quickly, in medical topics bibliometric analysis is already used as a research trend in disease studies or interventions (Yang GY, Wang LQ, Ren J, 2015), Used to measure a country that has a scientific research output, used to gain insight into changes in performance over time in a particular research area, used to identify cited publications and author characteristics, to explore hot topics of research in other fields (Koo, 2017).

Vickers uses the Medline database to determine a number of randomized features in complementary medicine trials, including the extent to which they are indexed, in which journals they are published, journal publication dates, and therapies and conditions to study (Vickers, 1998). Cao et al., (2023) in his research researched aromatherapy as a natural treatment method that uses essential oils (EO) extracted from aromatic plants; EO and its components exhibit a wide range of pharmacological activity, with a particular focus on its application to mental disorders, aiming to identify scientific articles and aromatherapy-related activities on anxiety, depression and insomnia through a bibliometric approach. From Ginting et al., (2023) which conducts research related to Essential oils used as potential therapies in the treatment of coronavirus disease 2019 (COVID-19). Many researchers have attempted to address the pandemic by exploring antiviral candidates that consequently changed the research landscape. The purpose of the study was to assess the effect of the COVID-19 pandemic on the essential oil research landscape using bibliometric methods.

Other research that uses bibliometric methods from the field of agriculture is from Zheng et al., (2023) which aims at identifying leading publications, authors, countries, and topics in *Hotpots on Root Exudates Research* to help ecologists and phytologists adapt and radiate future research frameworks. In the world of medicine, bibliometric analysis is carried out on research Li et al., (2023) by examining drug resistance in *Helicobacter pylori* to influence eradication therapy, the aim of this study was to assess progress in this area using a bibliometric approach. Publications related to *H. pylori* resistance from 2002 to 2022 are taken from the Web of Science database. Therefore, based on this research, the topic of patchouli (*Pogostemon Cablin*) uses bibliometric analysis to study the profile of research articles published in a decade, namely 2013-2023 and to identify topical relationships in research in agriculture. To find out the development of patchouli plant research.

MATERIALS AND METHODS

Scopus is a company that publishes scientific information in the academic world originating from the Netherlands, and is one of the largest providers of context, technical and health focused scientific information in the world. In this study we identified research articles with patchouli topics. The study was conducted on July 27, 2023. The publication period is limited to 2013-2023. Scientific articles and reviews are selected for further analysis. From the records analyzed to be used as citations, including publications, years, languages, countries or regions, journals, articles and authors using *Microsoft Excel 2016* software (Garfield E, Paris SW, 2006).

The distribution of the data examined is from the frequency of authors and the number of publications they are adjusted to the distribution function described by the law Lotka uses computer programs to obtain the value of n (log-log plot slope) and the constant c (fraction of authors with only one publication) (LOTKA version 1.02). The observed deviations between the functions of the theoretical distribution were evaluated using the Kolmogorov-Smirnov test (Rousseau B, 2000). The frequency of the journal and the number of articles contained will also be evaluated with a computer program (Rousseau B, 2000).

VOSviewer v.1.61 for Microsoft Windows, used to build bibliometric diagrams for visualization, quotations between quotations from scientific articles and event relationships from collections of writing taken from the title and abstract field of scientific articles (Koo, 2017). Collaboration can be interpreted as two authors who have been cited by other authors, so the more articles that are cited together with other authors and the more likely that they are related to each other (Small H, 1973). Fraction calculation is the method used when constructing co-citations, using fractions, if another scientific article that cites contains n references with each citation will only count $1/n$ of the total citation (Koo, 2017).

Co-occurrence analysis, text mining that looks at the function of VOSviewer is first to identify noun phrases in a collection of text based on the Apache OpenNLP Toolkit, and then convert all noun plural phrases to singular (Van Eck NJ, 2011). In this study, noun phrases that were said to be "terms" identified from VOSviewer were also examined manually, while Words with similar meanings or abbreviations would be combined into official forms, for terms deemed uninformative such as "year", "change", and publisher name were omitted to improve the clarity generated by the research network (Koo, 2017).

RESULTS AND DISCUSSION

A total of 303 scientific articles were published related to patchouli (*Pogostemon Cablin*) published between 2013-2023 taken from Scopus. The distribution of article types will be shown in Table 1 out of the total of 236 (77.9%) are original articles and 15 (5%) are review articles. These 251 collected articles will be included in the next analysis. Figure 1 shows that the number of articles has increased steadily over the 10-year period published in 2022 which amounted to 46 articles, Most of the articles are in English (17.8%) in Table 2. Authors from a total of 37 countries or regions contributed to 251 published articles. China has the largest publications (38.8%), followed by India (13.7%) and Indonesia (12.7%). In citations per paper, Malaysia in Table 3 is the country that occupies the highest quotation per paper (69.63%).

Of the 160 authors who wrote articles related to patchouli (*Pogostemon Cablin*), Cheng Peng from Chengdu University of Traditional Chinese Medicine wrote 12 articles (7.5%), Liang Xiong from Chengdu University of Traditional Chinese Medicine wrote 9 journals (5.6%), Likai Chen from Guangzhou University of Chinese Medicine as many as 9 articles (5.6), Zireng Ren Su from Guangzhou University of Chinese Medicine as many as 8 articles (5%), and Mohan Lal from the North East Institute of Science and technology with 8 articles (5%). Three of the authors have a background in medical

studies. 154 other authors wrote patchouli related articles (Pogostemon Cablin) as many as 5 authors wrote 7 articles (4.4%), 10 authors wrote 6 articles (3.8%), 13 authors wrote 5 articles (3.1%), 19 authors wrote 4 articles (2.5%), 28 authors wrote 3 articles (1.9%), 79 authors wrote 2 articles (1.3%).

Table 1. Distribution of types of articles on patchouli (Pogostemon Cablin) (N=303)

| Type | n | % |
|-------------------|-----|------|
| Article | 236 | 77,9 |
| Book chapter | 3 | 1,0 |
| Conference paper | 43 | 14,2 |
| Conference review | 2 | 0,7 |
| Erratum | 2 | 0,7 |
| Letter | 1 | 0,3 |
| Note | 1 | 0,3 |
| Review | 15 | 5,0 |

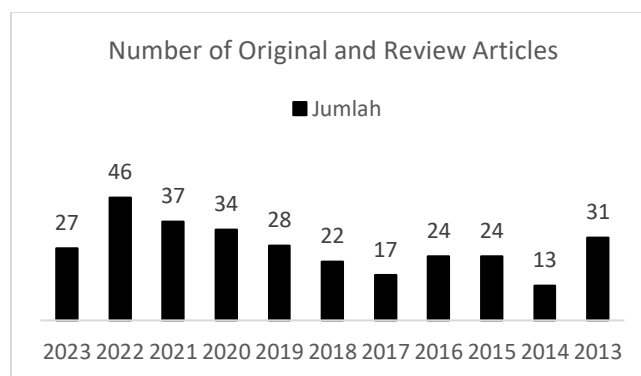


Figure 1. Time trend of the number of original articles and reviews in patchouli research (Pogostemon Cablin) published for the period 2013-2023

Table 2. language used in the original article and review of patchouli (Pogostemon Cablin) published in 2013-2023 (N=251)

| Bahasa | n | % | TGCS | Citation/article |
|-----------|-----|-------|------|------------------|
| China | 14 | 5,58 | 27 | 1,93 |
| Inggris | 232 | 92,43 | 4124 | 17,78 |
| Jerman | 1 | 0,40 | 5 | 5,00 |
| Indonesia | 1 | 0,40 | 0 | 0,00 |
| Portugis | 2 | 0,80 | 2 | 1,00 |
| Russia | 1 | 0,40 | 0 | 0,00 |

TGCS total global score = number of citations cited
 Citation/article = TGCS/number of articles

Of the 251 articles published in 171 different journals. Table 2 shows the 20 journals with the highest score, namely the number of original articles and reviews related to patchouli (Pogostemon Cablin). Five of them are from the agriculture and biological science category. By having a median value of an impact factor of 1.84 and thirteen is a journal quartile of 1, three is quartile 2, three is quartile 3 and one is quartile 4. According to the classification of the Journal Citation Reports related to the number of articles published in each journal Industrial Crops and Products published (12 articles), Journal of Essential Oil Bearing published (10 articles), Frontiers in Pharmacology (6 articles), Zhongguo

Zhongyao Zazhi, Molecules and Frontiers in Plant Science (5 articles), International Immunopharmacology (4 articles), then 8 other journals published (3 articles), 24 journals published (2 articles) and 132 journals published (1 article).

Table 3. More than 10 excerpts from original articles and reviews on patchouli (*Pogostemon Cablin*) published between 2013-2023

| No | Country | Journal | % | TGCS | Citation/Article |
|----|---------------|---------|------|------|------------------|
| 1 | China | 113 | 38,8 | 1724 | 15,26 |
| 2 | India | 40 | 13,7 | 577 | 14,43 |
| 3 | Indonesia | 37 | 12,7 | 395 | 10,68 |
| 4 | Brazil | 17 | 5,8 | 232 | 13,65 |
| 5 | United States | 16 | 5,5 | 342 | 21,38 |
| 6 | Malaysia | 8 | 2,7 | 557 | 69,63 |
| 7 | Macao | 6 | 2,1 | 162 | 27,00 |
| 8 | Japan | 6 | 2,1 | 72 | 12,00 |
| 9 | Hong Kong | 5 | 1,7 | 32 | 6,40 |
| 10 | Germany | 5 | 1,7 | 127 | 25,40 |
| 11 | Taiwan | 3 | 1,0 | 18 | 6,00 |
| 12 | South Korea | 3 | 1,0 | 16 | 5,33 |
| 13 | Australia | 3 | 1,0 | 45 | 15,00 |
| 14 | Thailand | 2 | 0,7 | 9 | 4,50 |
| 15 | Poland | 2 | 0,7 | 6 | 3,00 |

TGCS total global citation score = number of citations received
 Citation/article = TGCS/number of articles

Next, the 31 highest journals (18.2% of 171 journals) accounted for 80 or 31.9% of 251 journals. Table 3 shows more than 10 excerpts from original articles and reviews on patchouli (*Pogostemon Cablin*) published between 2013-2023. The highest ranked journal with 226 citations, which has been published in the journal Molecules. The second rank of articles that have been published is Industrial Crops and Products in 2016 with a total of 116 citations. At the beginning of the article publishing year, the longer the duration for an article has the opportunity to be cited, the score quotes per year will also be calculated, in order to provide index differences in comparison. The articles found will also be positioned based on the number obtained from the number of citations on Scopus.

Visualization of the analysis of quotation data that has been explored using VOSviewer. Figure 2 shows the results of the co-citation analysis of 171 accepted journals there are 31 joint citations. The size of the circle in the analysis results shows the number of citations in the journal that have been received, while the distance between the two journals shows the strength of the relationship between journals. Six clusters containing 31 journals were identified. Cluster 1 (red) consists of 14 journals related to the Journal of Essential Oil Bearing Plant, Cluster 2 (green) with the Journal of Essential Oil Research item is related to 15 journals, Cluster 3 (dark blue) with the Frontiers in Pharmacology item has 7 journals that are related, Cluster 4 (yellow) with the Journal of Ethnopharmacology item has 11 related journals, Cluster 5 (purple) with International Immunopharmacology journals has 8 related journals, Cluster 6 (bright blue) with the highest number of 18 related journals from Industrial Crops and Products. Figure 3. Indicates a network of co-occurrence terms that appear in titles and abstracts with a minimum number of 20 articles. Overall, 38 of the 7295 terms met the criteria and the top 60% of the most relevant terms were the 23 terms shown in figure 4. Cluster 1 (red) has 12 terms of occurrence together and the term of occurrence together is "patchouli" there are 112 events together, followed by "essential oil" there are 104 events together. Cluster 2 (green) has 9 tribes with "pogostemon cablin" receiving 175 Joint Occurrences and "patchouli alcohol" having 22 tribes with

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103 Shared Genesis. Cluster 3 (blue) has 2 tribes with "benth" and "blanco" which have a joint occurrence of 64 and 61 events.

Table 4. Top 20 original articles and reviews related to patchouli (*Pogostemon Cablin*) published in 2013-2023 (N = 251)

| | Journal | Scopus Subject Category | No. of Cited Article | % | TGCS | Citation/Article | Impact Factor | |
|----|---|--|----------------------|-----|------|------------------|---------------|-----|
| 1 | Industrial Crops And Products | Agricultural and Biological Sciences | 12 | 4,8 | 240 | 20 | 2.55 | Q1. |
| 2 | Journal Of Essential Oil Bearing Plants | Biochemistry, Genetics and Molecular Biology | 10 | 4 | 127 | 12,7 | 0.74 | Q2. |
| 3 | Frontiers In Pharmacology | Pharmacology, Toxicology and, Pharmaceutics | 6 | 2,4 | 89 | 14,8 | 1.53 | Q1. |
| 4 | Zhongguo Zhongyao Zazhi | Pharmacology, Toxicology and, Pharmaceutics | 5 | 2 | 6 | 1,2 | 0 | Q3. |
| 5 | Molecules | Biochemistry, Genetics and Molecular Biology | 5 | 2 | 246 | 49,2 | 1.97 | Q1. |
| 6 | Frontiers In Plant Science | Agricultural and Biological Sciences | 5 | 2 | 15 | 3 | 2.07 | Q1. |
| 7 | International Immunopharmacology | Pharmacology, Toxicology and, Pharmaceutics | 4 | 1,6 | 143 | 35,8 | 2.12 | Q1. |
| 8 | Rsc Advances | Chemistry | 3 | 1,2 | 106 | 35,3 | 3.09 | Q1. |
| 9 | Revista Brasileira De Plantas Medicinai | Pharmacology, Toxicology and, Pharmaceutics | 3 | 1,2 | 8 | 2,67 | 0.16 | Q4. |
| 10 | Pest Management Science | Agricultural and Biological Sciences | 3 | 1,2 | 100 | 33,3 | 3.03 | Q1. |
| 11 | Journal Of Ethnopharmacology | Pharmacology, Toxicology and, Pharmaceutics | 3 | 1,2 | 86 | 28,7 | 1.69 | Q1. |
| 12 | Journal Of Essential Oil Research | Chemistry | 3 | 1,2 | 52 | 17,3 | 1.08 | Q2. |
| 13 | Chinese Traditional And Herbal Drugs | Pharmacology, Toxicology and, Pharmaceutics | 3 | 1,2 | 2 | 0,67 | 0.22 | Q3. |
| 14 | Chemistry And Biodiversity | Biochemistry, Genetics and Molecular Biology | 3 | 1,2 | 32 | 10,7 | 2.06 | Q2. |
| 15 | Biomedicine And Pharmacotherapy | Pharmacology, Toxicology and, Pharmaceutics | 3 | 1,2 | 77 | 25,7 | 3.4 | Q1. |
| 16 | Revista Brasileira De Farmacognosia | Pharmacology, Toxicology and, Pharmaceutics | 2 | 0,8 | 49 | 24,5 | 2.45 | Q1. |

| | | | | | | | | |
|--------|-------------------------------------|--|---|-----|------|------|------|-----|
| 17 | Protein Expression And Purification | Biochemistry, Genetics and Molecular Biology | 2 | 0,8 | 33 | 16,5 | 0.83 | Q3. |
| 18 | Plos One | Multidiciplinary | 2 | 0,8 | 16 | 8 | 0.53 | Q1. |
| 19 | Planta Medica | Biochemistry, Genetics and Molecular Biology | 2 | 0,8 | 20 | 10 | 0.64 | Q1. |
| 20 | Pharmacological Research | Pharmacology, Toxicology and, Pharmaceutics | 2 | 0,8 | 88 | 44 | 2.93 | Q1. |
| Median | | | | | 64,5 | 16,9 | 1,83 | |

Table 5. Top 10 citations from original articles and reviews related to patchouli (Pogostemon Cablin) published in 2013-2023 (N = 251)

| Rank | First Author | Title | | Impact Factor | Year | GCS | GCSY | No of Scopus Citation |
|------|-----------------|---|----------------------------------|---------------|------|-----|-------|-----------------------|
| 1 | Swamy M.K. (2) | A comprehensive review on the phytochemical constituents and pharmacological activities of Pogostemon cablin Benth.: An aromatic medicinal plant of industrial importance | Molecules | 1.97 | 2015 | 226 | 28,25 | 226 |
| 2 | Swamy M.K (4) | Patchouli (Pogostemon cablin Benth.): Botany, agrotechnology and biotechnological aspects | Industrial Crops And Products | 2.55 | 2016 | 116 | 16,57 | 116 |
| 3 | Jeong J.B. (5) | Patchouli alcohol, an essential oil of Pogostemon cablin, exhibits anti-tumorigenic activity in human colorectal cancer cells | International Immunopharmacology | 2.12 | 2013 | 88 | 8,80 | 87 |
| 4 | Kusuma H.S. (2) | The extraction of essential oils from patchouli leaves (Pogostemon cablin benth) using a microwave air-hydrodistillation method as a new green technique | Rsc Advances | 3.09 | 2017 | 84 | 14,00 | 83 |
| 5 | Huang S.-H. (9) | Insecticidal activity of pogostone against Spodoptera litura and Spodoptera exigua (Lepidoptera: Noctuidae) | Pest Management Science | 3.03 | 2014 | 46 | 5,11 | 45 |

| | | | | | | | | |
|----|----------------|--|---|------|------|----|------|----|
| 6 | Swamy M.K (4) | Evaluation of Patchouli (Pogostemon cablin Benth.) Cultivars for Growth, Yield and Quality Parameters | Journal Of Essential Oil Bearing Plants | 0.74 | 2015 | 27 | 3,38 | 27 |
| 7 | Lian D.-W. (9) | Unraveling the novel protective effect of patchouli alcohol against helicobacter pylori-induced gastritis: Insights into the molecular mechanism in vitro and in vivo | Frontiers In Pharmacology | 1.53 | 2018 | 25 | 5,00 | 25 |
| 8 | Xu W. (7) | Effects of Pogostemon cablin on gastrointestinal function of rats with syndrome of damp retention in middle-jiao | Zhongguo Zhongyao Zazhi | 0 | 2017 | 10 | 1,67 | 3 |
| 9 | Costa G.A. (3) | Yield and composition of the patchouli (Pogostemon cablin) essential oil according to the extraction time; [Rendimento e composição do óleo essencial de patchouli (Pogostemon cablin) conforme o tempo de extração] | Revista Brasileira De Plantas Mediciniais | 0.16 | 2013 | 5 | 0,50 | 5 |
| 10 | Manjesh K. (5) | Bio-Insecticidal Nanoemulsions of Essential Oil and Lipid-Soluble Fractions of Pogostemon cablin | Frontiers In Plant Science | 2.07 | 2022 | 4 | 4,00 | 4 |

- GCS (Global Citation Score) = citation frequency based on Scopus calculations from time and data that has been downloaded
- GCSY (Global Citation Score per Year) = GCS/(2023-year published)
- Number of Scopus citations obtained from <https://www.scopus.com>
- Impact factors are derived from the Field-Weighted citation impact metric in Scopus

Discussion

In this bibliometric context, the author presents the results of publications on the topic of patchouli (Pogostemon Cablin) published between 2013-2023. The trend analysis saw growth in the number of original articles and reviews over the period 2013-2023, language within articles, countries of unspecified findings included in the study's findings. Of the 251 articles reviewed, not all authors use English. There are 92.4% of articles written in English. It can be said that this is a finding that shows that English is a global language and is the language of scientific communication (Ferguson, 2007), akan tetapi ciri-ciri dari Science Citation Index yang berisi sedikit jurnal yang tidak menggunakan bahasa inggris (Van Leeuwen TN, Moed HF, Tijssen RJW, Visser MS, 2001).

From the data on the number of authors as many as 241, the two most prolific authors in patchouli topics revealed by this study are Mallapa Kumara Swami and Uma Rani Sinniah in the fields of Biochemistry, Genetics and Molecular Biology. The distribution of the number of articles that have

been published by the author, in this case the study is evaluated by the law of scientific productivity, namely the Law of Lotka (Lotka, 1926). Then when viewed based on statistical distribution in terms of author productivity with reference to Lotka's law observes that "the number of authors who make n contributions is about $1/n^2$ of the authors who make one, then the proportion of all contributors who make one contribution is about 60%." It can be interpreted that the number of authors producing n articles is proportional to $1/n^2$. Our study found that only 34 authors had contributions to five or more articles totaling 215 articles, out of 79 authors (14.8%) who contributed to two articles. However, LOTKA's calculation is according to Rouseaum B, (2000) cannot adjust the legal distribution of LOTKA to the data under study.

The distribution of data from 251 articles in 160 journals corresponds as shown in the Kolmogorov-Smirnov goodness-of-fit test. According to Lotka's law A is n of 0.21 and C with a value of 0.16 resulting from the calculation of LOTKA, resulting in the power function LOTKA can be expressed as $Y = 0.16 / X^{0.21}$, where Y is the number of the relative frequency of journal articles with X articles obtained 6.64. According to this formula, it results in that it can be estimated that the journal contains only one article. The value of n suggested by LOTKA will be greater than 2, but recently the citation data from the Scopus database says 3.5 (Brzezinski, 2015). While previous studies have shown that exponents n and constant c can be influenced by subject area and productivity, development of conditions, country of origin, research period and period length (Pulgarin, 2012). Most articles have concentrations from a few journals, from articles published in only three journals, namely the journal Industrial Crops And Products, Journal Of Essential Oil Bearing Plants, journal Frontiers In Pharmacology, and the journal Zhongguo Zhongyao Zazhi Therefore, these journals can be considered as core journals for the dissemination of patchouli-related knowledge (Pogostemon Cablin).

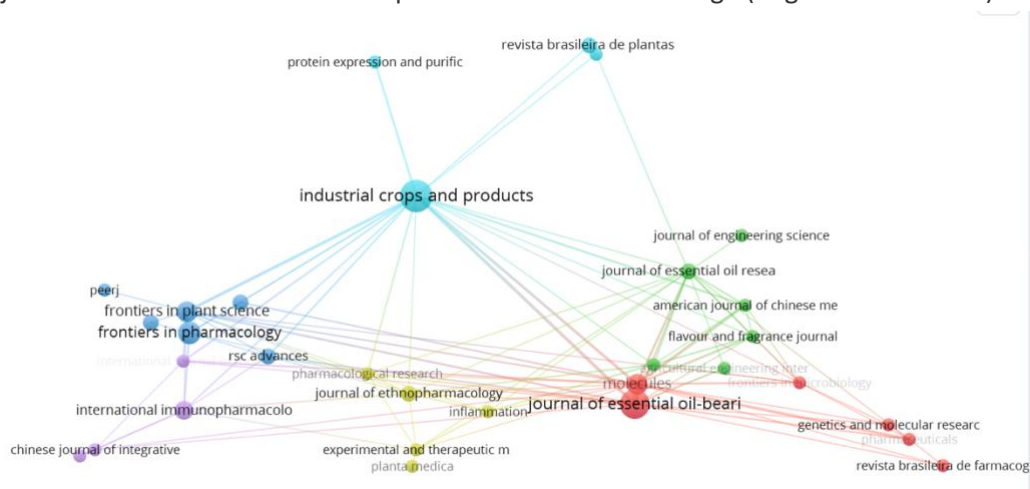


Figure 3. The relationship of events is concurrent in the title and abstract in patchouli-related articles (Pogostemon Cablin) published between 2013-2023. There are three clusters that have been identified, cluster 1 (red), cluster 2 (green), cluster 3 (blue)

Of the 10 original articles and reviews most cited in patchouli (Pogostemon Cablin) research published between 2013-2023 are those analyzed to display patchouli-related research types (Pogostemon Cablin) can be seen in Table 5. Reviews of articles with the highest citation rates with top ratings show findings on patchouli there are major phytochemical compounds namely patchouli alcohol, α -patchoulene, β -patchoulene, α -bulnesene, seychellene, norpatchoulenol, pogostone, eugenol and pogostol. Modern studies have revealed several biological activities such as antioxidant, analgesic, anti-inflammatory, antiplatelet, antithrombotic, aphrodisiac, antidepressant, antimutagenic, antiemetic, fibrinolytic, and cytotoxic activity (M. Swamy, 2015). Reviews of articles with a second rank provide comprehensive information on the basic and applied aspects of the

cultivation and management of patcholi plants (*Pogostemon Cablin*). The applied aspect of Patchouli Biotechnology allows one to explore newer potentials for various industrial uses and enhance rural economies due to its high economic value as a type of aromatic plant that can be beneficial for aromatic and medicinal industries (Mallappa Kumara Swamy & Sinniah, 2016).

Third is the article, these findings show that Patchouli Alcohol exerts anticancer activity by reducing cell growth and increasing apoptosis in human colorectal cancer cells. Proposed mechanisms include inhibition of HDAC2 expression and HDAC enzyme activity, and subsequent downregulation of c-myc and activation pathways NF-κB (Jeong, 2013). Fourth, in this research article, patchouli oil extraction was carried out using the microwave hydrodistillation method. In addition to optimizing the patchouli oil extraction process, This research uses the development of microwave hydrodistillation method, microwave air-hydrodistillation (Kusuma, 2017). The fifth and so on of the ten articles constitute articles, thus the most are occupied with the original article, therefore reasonable systematic and meta-analysis occupy the highest position currently proposed (Burns PB, 2010). In addition, ranks one to four have citations of more than 30, while ranks five to ten have citations of less than 30. In addition, there is another possible reason review articles have the highest citations is because review articles are often quoted in the introduction of the original article. A review of the 100 most cited articles in articles for 21 fields of science for the period 1996-2006 that found a large number of articles in each field were review articles (JP, 2006).

Visualization analysis by VOSviewer software was used in this study to create a two-dimensional co-citation mapping journal receiving 39 citations together (Figure 2). Six clusters containing 31 journals are generated by VOSviewer. Cluster 1 (red) was formed by 14 Journals of Essential Oil Bearings which became the focus of complementary medicine which was much the same from the other two clusters, cluster 2 (green) formed by 15 journals in the Journal Of Essential Oil Research with the most article distribution, namely Industrial Crops and Products, and cluster 3 (blue) formed by 7 journals Frontiers in Pharmacology. This distribution pattern shows that there is a high linkage between articles in each cluster, moderate linkage is found in clusters 6 and 1, 6 and 2, 6 and 3, 6 and 4, 6 and 5, for clusters 3 and 5 have no linkage with clusters 1 and 2.

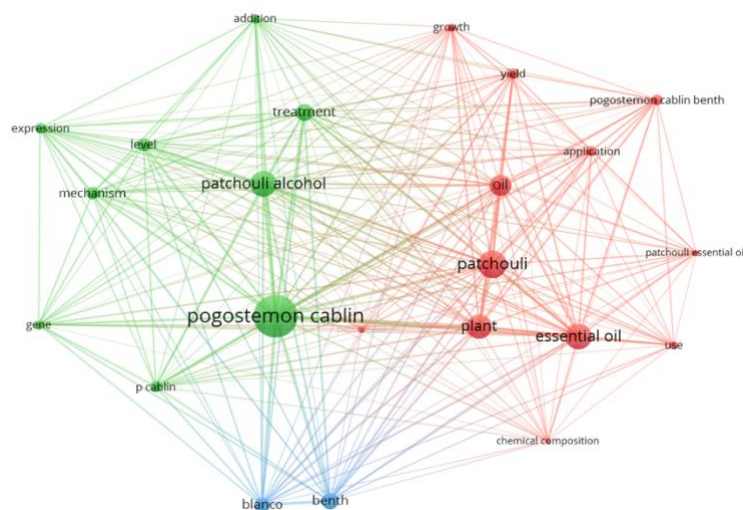


Figure 3. The relationship of events is concurrent in the title and abstract in patchouli-related articles (*Pogostemon Cablin*) published between 2013-2023. There are three clusters that have been identified, cluster 1 (red), cluster 2 (green), cluster 3 (blue)

To find popular research topics related to patchouli (*Pogostemon Cablin*) research published between 2013-2023, co-occurrence of each term in the title and abstract with a minimum of 20 articles appearing in the analysis, has formed three clusters with a total of 23 items with 247 connected items

each. Cluster 1 (red) in patchouli item dominance is one type (plant) that produces (oil) indicating that the quantity and quality of oil is not only influenced by environmental factors such as soil, climate and refining practices, but also depends on the genotype of cultivar. This study was conducted to evaluate six different patchouli cultivars for growth parameters, yield and quality with respect to patchouli alcohol according to M K Swamy, (2015), A total of 22 were connected for a total co-occurrence of 112.

Cluster 2 (green) with pogostemon cablin items dominated the number of studies that produced (patchouli alcohol) so that its content was used as a treatment for treatment connected to 22 other items and had a co-occurrence of 175. Systematic reviews emerged as a prominent term as 5.98% of the articles were reviews. The release of the term pogostemon cablin indicates several studies and reviews on well-cited surveys regarding the use of Pogostemon cablin Benth. (patchouli) is an important plant that has many therapeutic properties and is widely used in the aromatic industry. In the practice of traditional medicine, it is used to treat colds, headaches, fever, nausea, vomiting, diarrhea, abdominal pain, insect and snake bites. In aromatherapy, patchouli oil is used to relieve depression, stress, calm nerves, control appetite and increase sexual arousal, research has revealed M. Swamy, (2015), Jeong, (2013), Kusuma, (2017) and Huang et al., (2014).

Next, Cluster 3 (blue) with benth items is a variant type of patchouli plant followed by the next type of patchouli is blanco connected with 22 other items and has a co-occurrence of 64. This indicates that the emergence of each term that is often issued in each article in this study. Visualization in co-occurrence can help pinpoint potential or overlooked areas in the course of research (Koo, 2017). This intrinsic limitation of bibliometric analysis needs to be noted, namely the possibility of missing several articles because it uses a database of single citations. Further research can then evaluate other databases such as WOS and Google Scholar and compare these findings. Second, citation index data is biased towards journals with English, because journals using non-English nahasa have a lower impact than those using English (Van Leeuwen TN, Moed HF, Tijssen RJW, Visser MS, 2001). Thus affecting the output of the country where the journal has been published.

CONCLUSION

This study is a bibliometric analysis related to Patchouli (Pogostemon Cablin), by collecting a database of prolific authors, journals, and research groups related to patchouli in a decade (2013-2023). This research provides systematics of productivity and visibility of research on patchouli plants in agriculture, the pharmaceutical industry, aromatics and in the medical world. These findings can be used to direct, organize and as a priority in conducting future research related to patchouli.

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