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Nanocellulose Research Trends from Pineapple Plant Waste in Indonesia: Bibliometric Analysis Using VosViewer

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A B S T R A C T

The application of sustainable industry is carried out by utilizing pineapple plant waste by bibliometric and exploratory descriptive analysis using VOSviewer 1.6.18 software using a database of Scopus-indexed journal publishers. This study aimed to determine research trends on the utilization of pineapple plantation industry waste for nanocellulose production in Indonesia. The Scopus database collected information regarding Nanocellulose Research Trends From Pineapple Plant Waste. To obtain search results, subject categories with titles, keywords, and abstract criteria from Nanocellulose Research Trends From Pineapple Plant Waste were used as a reference. Using VOSviewer, search result extraction was performed. The results of bibliometric mapping were then further evaluated. The findings of the bibliometric study demonstrate through network visualization, overlay visualization, and density visualization that nanocellulose research in Indonesia has increased over the past seven years, beginning in 2015.

1. INTRODUCTION

1.1. Research Background

Agro-industry is any activity that uses agricultural products as a raw material source and provides tools and materials for those activities [1]. Agro-industrial activities will produce waste that, if not managed properly, will cause environmental problems. The pineapple plant is the plant that produces waste. The pineapple, or *Ananas comosus L*. Merr, is one of the most important horticultural products that is still being produced in Indonesia. The production of nanocellulose is one method of converting pineapple plant waste into a useful product. Several studies on nanocellulose have been carried out, and this research continues to grow today. Research publications regarding agro-industrial waste, especially pineapple plant waste, in a product, namely nanocellulose, require an analytical method that can map a large amount of scientific literature so that research trends can be identified that have not been widely carried out. Bibliometric analysis is one of the research tracking methods that can be used to find out the boundaries and latest developments of a research topic.

Bibliometric analysis is a method of analyzing trends in research topics, developments in the number of studies, and patterns of authors of publications [2]. A bibliometric analysis was performed to determine the distribution of publications and citations from various literature. By examining the nature and progress of the science in question, bibliometric indicators can provide a higher level of development [3]. Database sources can be searched using Scopus data. The choice to use Scopus is because Scopus is one of the citation and scientific literature databases (data centres) owned by the world's leading publisher, Elsevier. In bibliometric analysis, software called VOSviewer is needed to visualize the analysis results. VOSViewer is a computer program used to visualize bibliometric maps. VOSViewer can present and visualize special information about bibliometric chart maps, making it easier to interpret a relationship or network [4].

2. METHODS

This research uses explorative, descriptive research. The method used in this research is the literature study method regarding the research trend of nanocellulose from pineapple waste. Search data via the Scopus website (www.scopus.com) with the keywords: "ALL (cellulose AND nanocellulose AND pineapple AND pineapple AND waste) AFFILCOUNTRY (Indonesia)", YEAR LIMIT (2000-2022). Documents from the Scopus website are saved in the form of. RIS-type files and .csv-type files. Bibliometric analysis was conducted using VOSviewer 1.6.18 for Windows software.

3. RESULTS AND DISCUSSION

Until the data was collected and screened on November 20, 2022, based on predetermined keywords, 110 scientific articles and publication documents were obtained (Fig. 1).

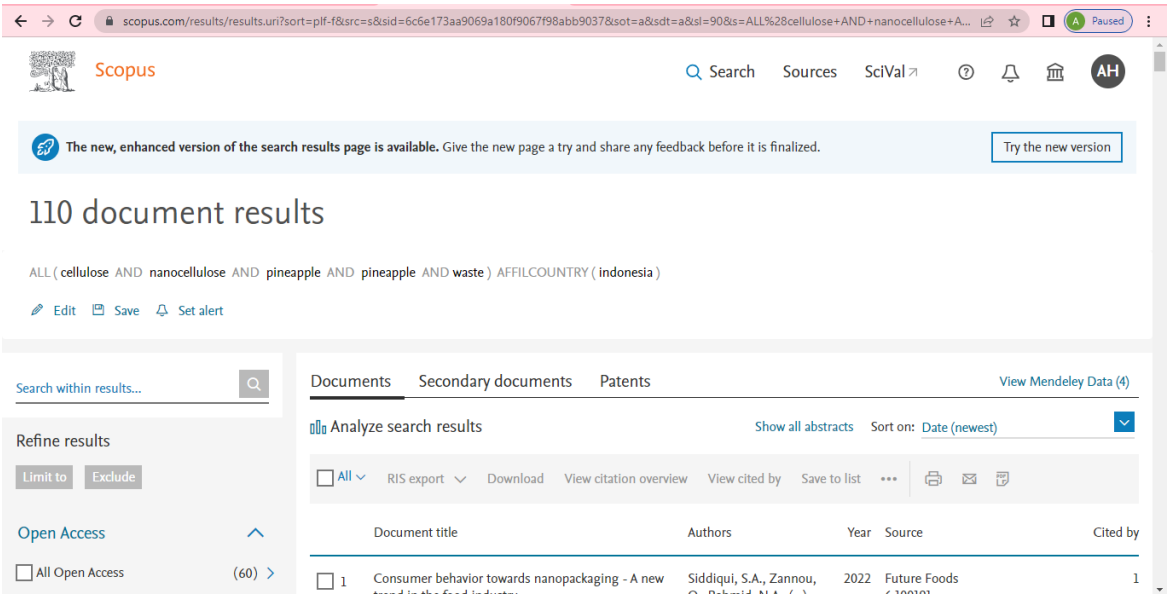

Fig. 1. Search Results Based on Selected Keywords

3.1. Publication Trends by Publication Year

The development of nanocellulose from pineapple plant waste was only developed in 2015, as shown in Fig. 2. In 2015, there was only one study; then, from 2016 to 2021, there was an increasing trend, even though in 2022, there was a slight decrease. In 2021, 30 studies were published, which was the year with the most publications.

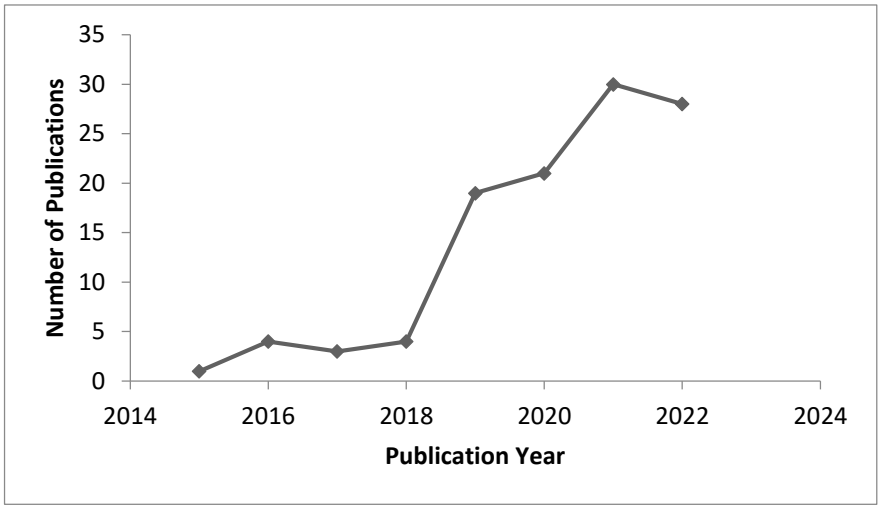

Fig. 2. Graph of Number of Publications by Year

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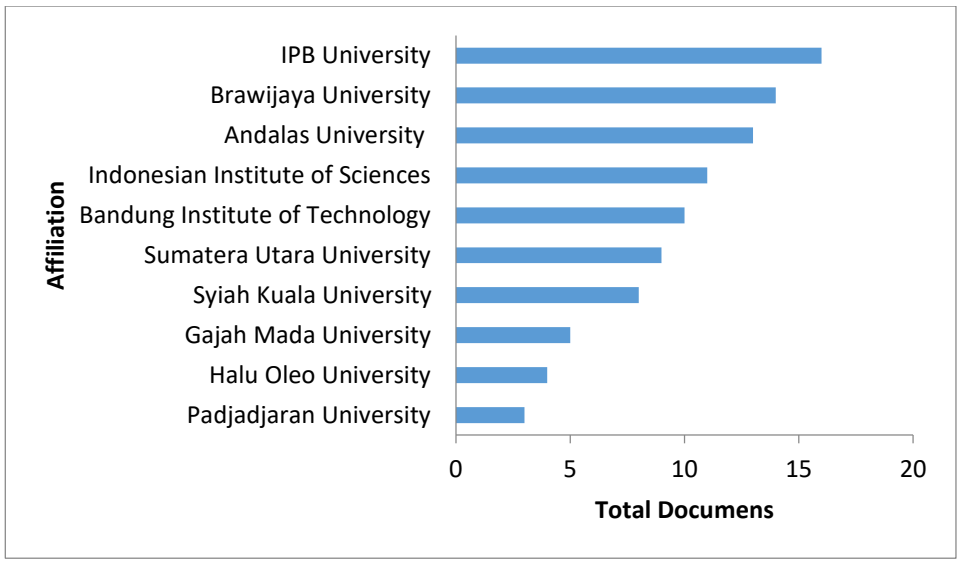

Fig. 3. The Highest Affiliation In the Publication Of Scientific Journals or Articles

3.2. Analysis of Affiliation Productivity

In 110 journal publications and scientific articles, Affiliation productivity shows that 169 affiliations contributed to using pineapple waste in nanocellulose. Fig. 3 shows the highest affiliation in the publication of scientific journals or articles about nanocellulose from pineapple waste.

Fig. 3. shows that of the top 10 affiliations, IPB University has the highest number of publications, with 16 scientific journals or articles. In contrast, Padjadjaran University has the fewest publications, with three scientific journals or articles regarding nanocellulose from pineapple plant waste.

3.3. Analysis of Productivity Authors

There are ten authors among the 441 authors who meet the standards for productivity: a minimum of 5 publications and a maximum of 25 publications.

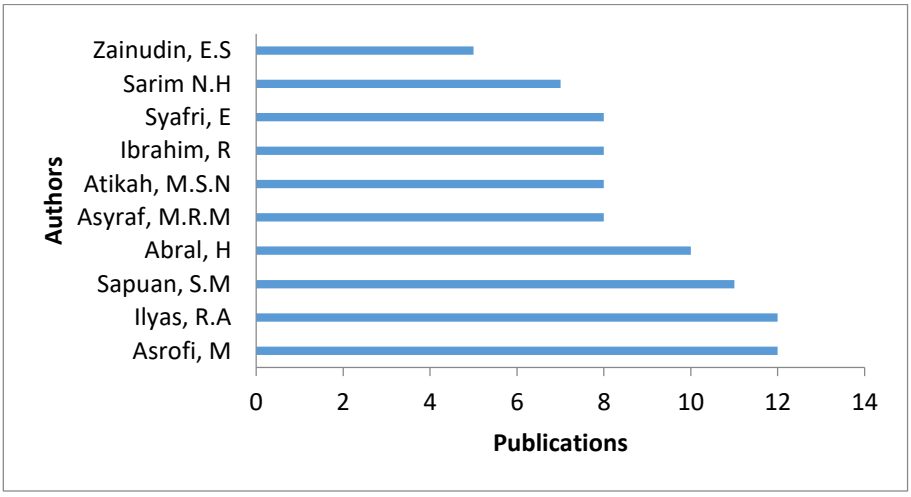

Fig. 4. Graph Of The 10 Most Productive Authors

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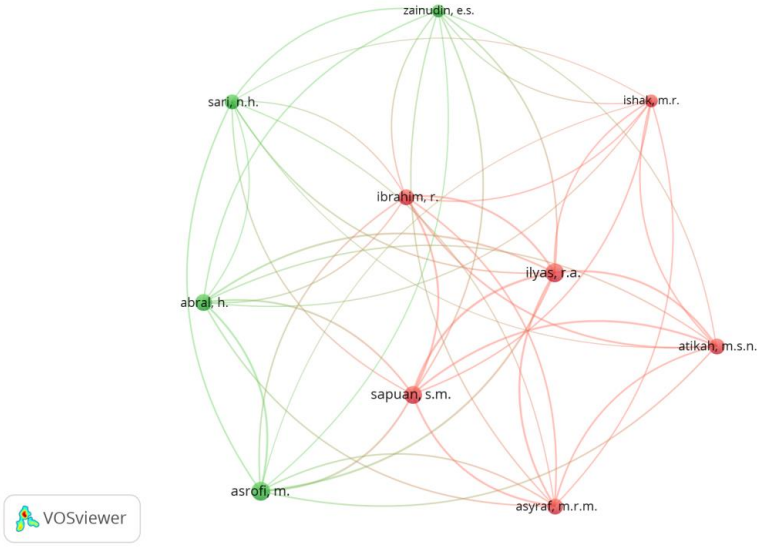

Fig. 5. Network Visualization the Most Productive Authors

This study also developed a network visualization to analyze the writer's productivity.. Fig. 5. shows the correlation of 10 researchers regarding the utilization of pineapple plant waste into nanocellulose. According to the data, only four of the ten most productive researchers are Indonesian, while the other six are from other countries. It turns out that researchers from Indonesia are still doing little research on nanocellulose, so researchers in Indonesia are collaborating with researchers from abroad (Malaysia). Therefore the names of researchers from Malaysia appear in the analysis using this variable even though the search with Scopus has chosen an affiliate from Indonesia.

3.4. Research Development Map of Nanocellulose From Pineapple Plant Waste

From Vosviewer, mapping the development of nanocellulose research from pineapple plant waste is obtained through the selected keywords, as seen in Fig. 6.

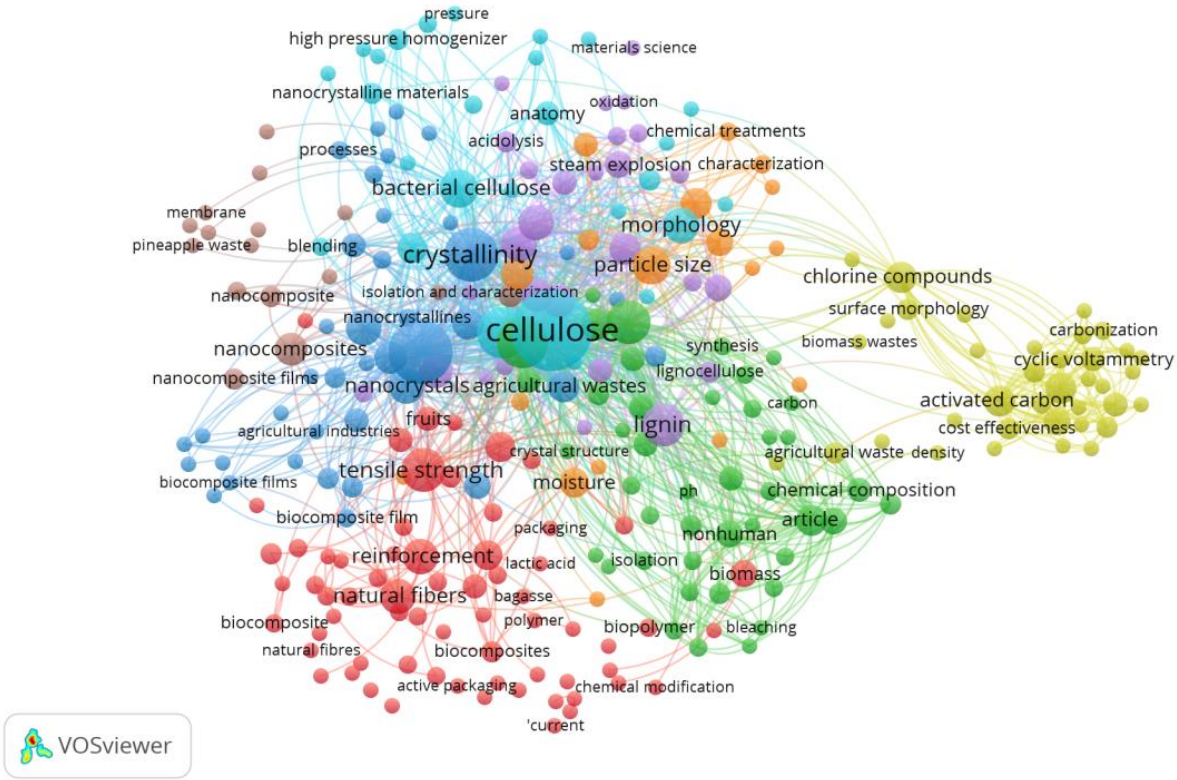

Fig. 6. Network Visualization Results of Topic Mapping of Nanocellulose from Pineapple Plant Waste

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Cellulose is the most abundant organic compound, a glucose polymer in the form of a linear chain connected by β-1,4 glycosidic bonds [5]. Cellulose is environmentally friendly because it is easily degraded, non-toxic, and renewable [6]. Nanocellulose is a natural fibre that can be extracted from nanosized cellulose. Nanocellulose has the advantages of being inexpensive, biocompatible, renewable, highly reactive, and having ideal physical attributes such as lightweight, high stiffness, tensile strength, strength-to-weight ratio, optical transparency, and low expansion upon heating [7]. Cellulose can be categorized into three main types: nanocrystalline, nano-fibrillated, and bacterial cellulose [8]. Cellulose nanocrystals and nano-fibrillated cellulose are shown in Fig. 7, while Fig. 8 shows bacterial cellulose.

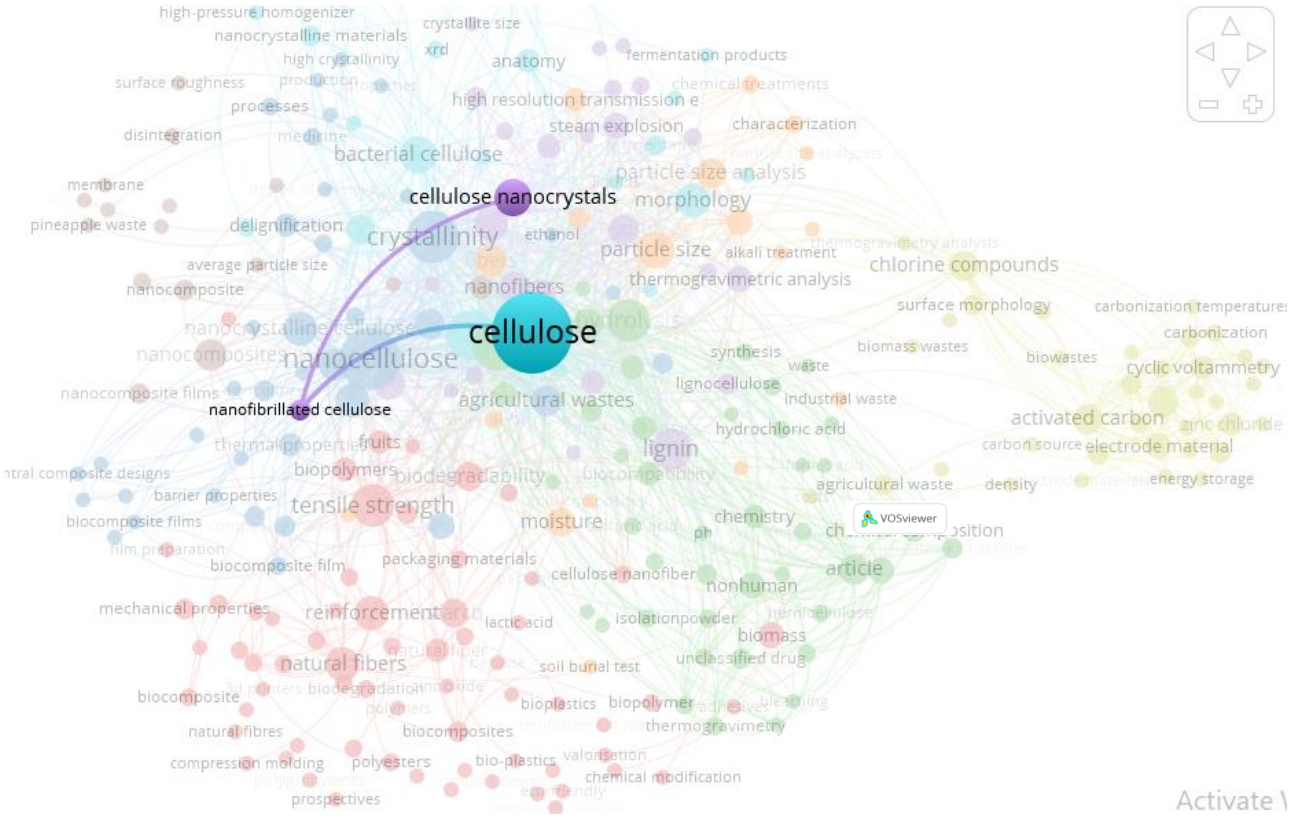

Fig. 7. Cellulose Nanocrystals dan Nanofibrillated Cellulose

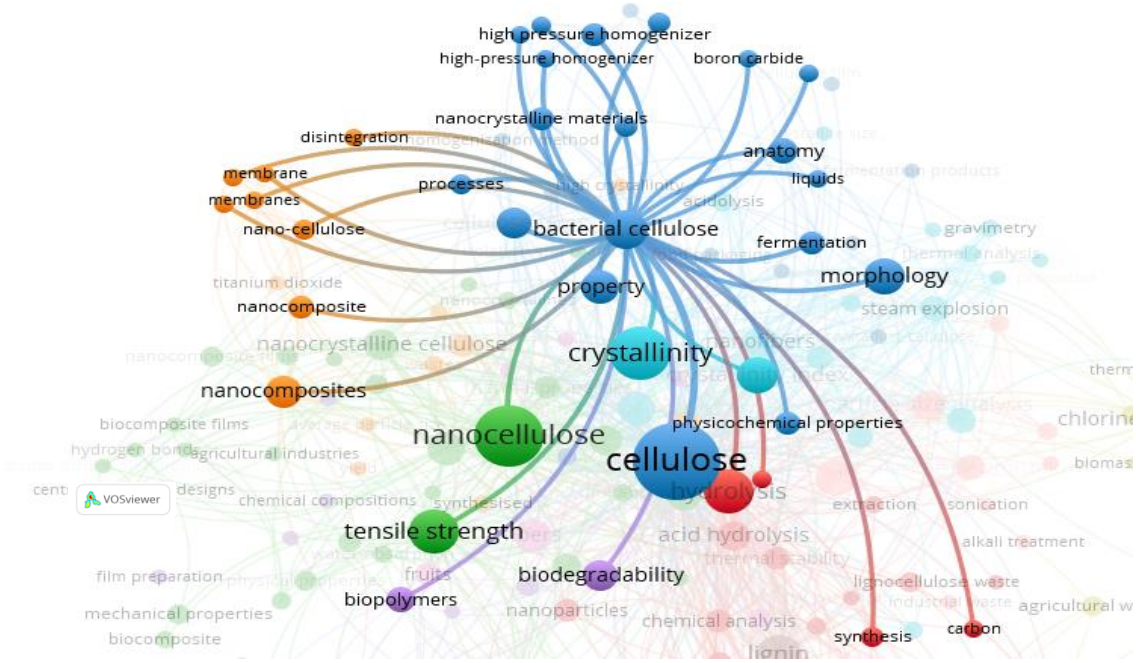

Fig. 8. Bacterial Cellulose

Research on cellulose nanocrystals and nano fibrillated cellulose from pineapple plant waste seems not to have been done much. It has been proven that there is only one direct connection or line to cellulose. It is different. The case of bacterial cellulose seems to have many branches, which means that there has been much research. In addition, the network visualization in Fig. 6 shows the utilization of pineapple plant waste that researchers have used.

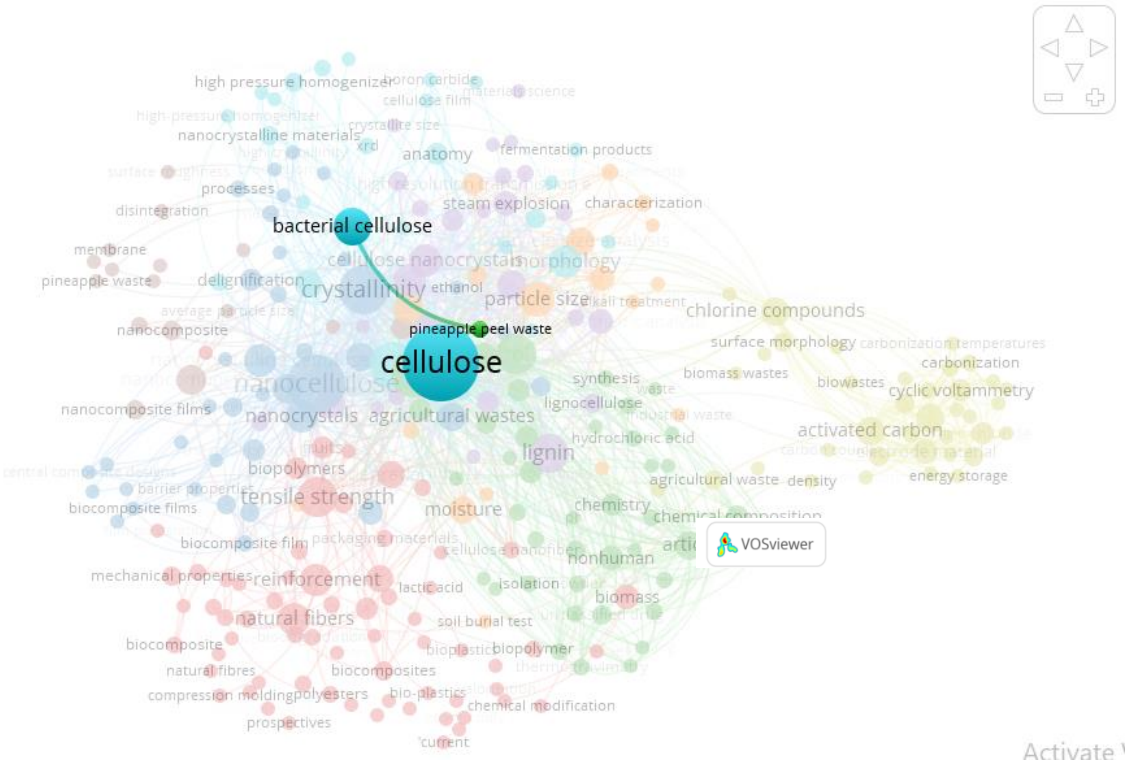

Fig. 9. Utilization of Pineapple Peel Waste for Bacterial Cellulose

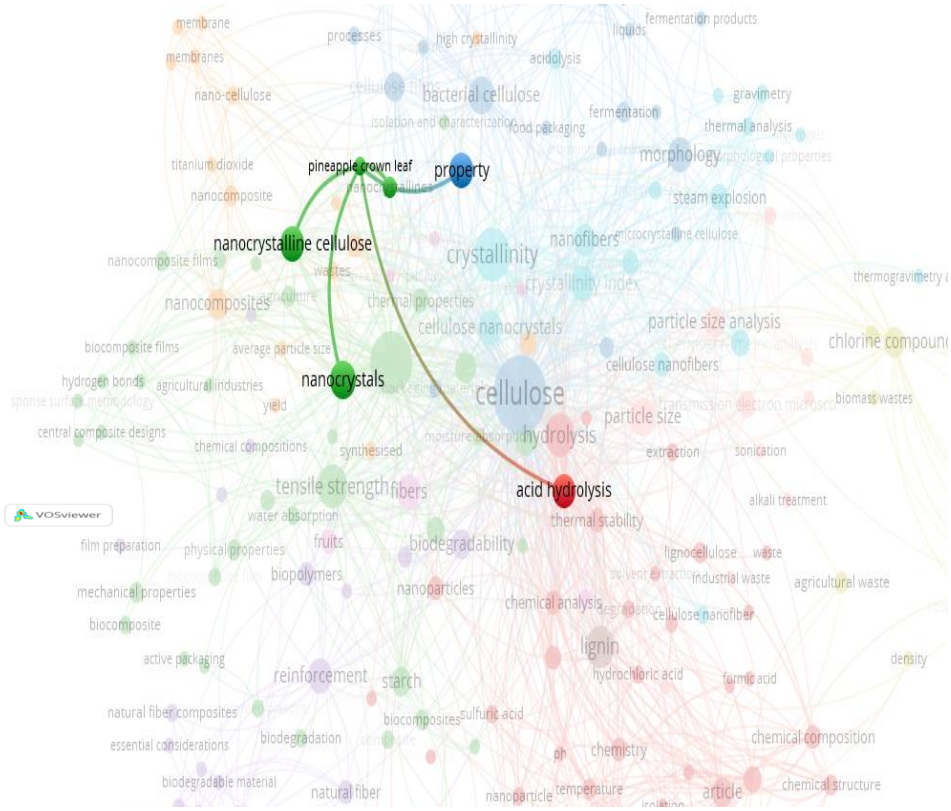

Fig. 10. Utilization of Pineapple Crown Leaf for Cellulose Nanocrystals

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The network visualization in Fig. 9. shows the utilization of pineapple peel waste in bacterial cellulose to make nata de pina. Nata de pina is fermented nata made from raw material derived from pineapple peel waste with the help of Acetobacter xylinum bacteria [9]. Cellulose Nanocrystals from pineapple crown leaves were successfully produced using acid hydrolysis with sulfuric acid [10]; [11].

4. CONCLUSION

The bibliometrictric analysis contributes to the study by outlining theoretical and methodological timeframes that may be applied in various situations. In particular, the key conclusions from the bibliometric analysis utilizing Vosviewer software highlight publishing trends by year, the institutions that contribute the most, the authors that produce the most, and research advancements related to nanocellulose from pineapple plant waste. Additionally, it examines how researchers establish mutually beneficial relationships with one another through network visualization bibliographies based on authors, as well as how research evolves using keywords. The findings of the bibliometric study demonstrate through network visualization, overlay visualization, and density visualization that nanocellulose research in Indonesia has increased over the past seven years, beginning in 2015. IPB University has the highest number of publications, with 16 scientific journals or articles

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