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Exploring the Nutritional Potential of *Jatropha curcas* on Body Metabolism: A Bibliometric Analysis

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Abstract

Background: a natural source that has great potential as a source of antioxidants is Jatropha curcas (L.). This plant has attracted widespread attention due to its significant content of antioxidant compounds in various parts of the plant, including leaves, seeds, and roots. In addition to health benefits, Jatropha curcas also has applications in various fields, including body metabolism.

Methods: This research aims to gain a comprehensive insight into research trends, research collaborations, as well as researchers' contributions in the field of Jatropha's nutritional potential for body metabolism. The research method used is qualitative research with a literature review.

Results: The results of overlay visualization in 2021 showed that there were many studies conducted on Jatropha curcas. The level of density in the image is indicated by the number of keywords that often appear and can be marked with yellow Jatropha curcas has not been studied much. This indicates a research gap that exists in current onomastic research so the opportunity to research this topic is still very broad.

Conclusion: A contribution to healthcare research can be made by involving Jatropha curcas as a potential source of antioxidants. The health benefits derived from antioxidant compounds found in various parts of this plant, including leaves, seeds, and roots, offer a positive contribution to health research. Additionally, insights into the application of Jatropha curcas in enhancing body metabolism open opportunities for the development of therapies or supplements that can support human health and well-being.

Keywords: Biological, Jatropha, Metabolism, Nutrient

Introduction

The *Jatropha curcas* L. plant is a promising natural source as an antioxidant provider. This plant has been a major focus due to the significantly substantial content of antioxidant compounds in various parts, such as leaves, seeds, and roots. Apart from providing diverse health benefits, *Jatropha curcas* also has broad applications in various sectors, including bioenergy, waste processing, and supporting sustainable agriculture [1].

The *Jatropha curcas* plant, also known as the physic nut, belongs to the Euphorbiaceae family and is a perennial plant capable of withstanding drought. This plant originates from Latin America and now grows in tropical regions with dry and semi-arid climates. Its seeds contain approximately 35% oil, making them toxic. The *Jatropha curcas* plant serves various purposes, such as producing alternative fuel, soap-making materials, and utilizing fruit husks and capsules for compost. Additionally, it is used as a medicinal plant. Its seeds are employed to treat constipation, its latex is used for wound healing, and its leaves are used to combat malaria[2].

Indonesia is a country renowned for its abundant biodiversity, with many plants that can be used for medicinal purposes. People in Indonesia believe that medications derived from natural sources rarely have adverse side effects. The leaves of the *Jatropha curcas* plant are utilized as traditional medicine in Indonesian communities. With ethanol extraction, *Jatropha curcas* leaves contain a high concentration of secondary metabolites, which are active compounds such as saponins, flavonoids, and polyphenols. Additionally, the leaves contain tannins[3].

The latex of *Jatropha curcas* L., known as physic nut, is a plant recognized for its medicinal properties. This plant contains active compounds such as flavonoids, tannins, saponins, terpenoids, and alkaloids, known for their antibacterial properties, meaning they can inhibit bacterial growth. Additionally, the latex of *Jatropha curcas* L. serves as an anti-inflammatory, anticancer, antifungal, analgesic, and disinfectant or antiseptic. The latex of *Jatropha curcas* L. is used as a remedy for acute pulpitis in teeth[4].

Antioxidants are compounds with the ability to protect human and animal cells from damage caused by free radicals and oxidative stress. In the context of human health, antioxidants can help prevent various chronic diseases, such as cancer, diabetes, and heart disease. This research aims to explain how data is collected, processed, and analyzed to gain a comprehensive insight into research trends, collaboration, and researchers' contributions in the field of antioxidants in *Jatropha curcas*[5].

Although research on antioxidants in *Jatropha curcas* has rapidly advanced, there is still a need for a comprehensive bibliometric review to understand the trends and impact of such research in the scientific literature. Bibliometric analysis provides an in-depth understanding of the development of research, scientific collaboration, research focus, and the contributions of researchers in a specific field.

In this context, this bibliometric journal aims to fill knowledge gaps by analyzing scientific literature related to the nutritional potential of *Jatropha curcas*. This analysis will help identify research developments, and contributions from specific institutions and researchers, and foster a better understanding of this topic. The results of this bibliometric analysis will provide valuable insights for the scientific community, researchers, and policymakers to guide further efforts in exploring the nutritional potential for body metabolism in *Jatropha curcas* across various applications. It will also facilitate a deeper understanding of the relationship between this plant and human health.

Methods

Bibliometric analysis evaluates registered literature, including journal articles and conference proceedings. This method involves the assessment and interpretation of data using statistical techniques and the collection of publication information such as authors, journals, publication years, and citation counts. A total of 480 journal articles and 47 conference papers were identified in the Scopus database, with the overall metadata reaching 527 records. The study's timeframe spans from 2018 to 2023. Furthermore, co-occurrence analysis was conducted using the VOSViewer software, visually presenting the network or bibliometric relationships among keywords.

This analysis can be utilized to address various research questions, such as identifying trends in the research field, measuring the impact of specific publications or authors, or comparing the performance and productivity of various research groups. Data collected from these inquiries will be stored in the form of spreadsheets (CSV/VOS)[6].

The research method employed is qualitative research with a literature review. The literature review serves to gather findings from previous research to obtain a general overview of the topic. Collaboration methods can also be applied by combining literature analysis and cluster analysis methods. This method involves analyzing literature and bibliographic data from academic works, including authors, titles, journals, publication years, and keywords. The analysis aids in identifying research trends, the most productive journals, and the evolution of research topics. Cluster Analysis is a method used to identify groups or clusters of academic works that share similar topics or themes. It helps in identifying different research areas within a field.

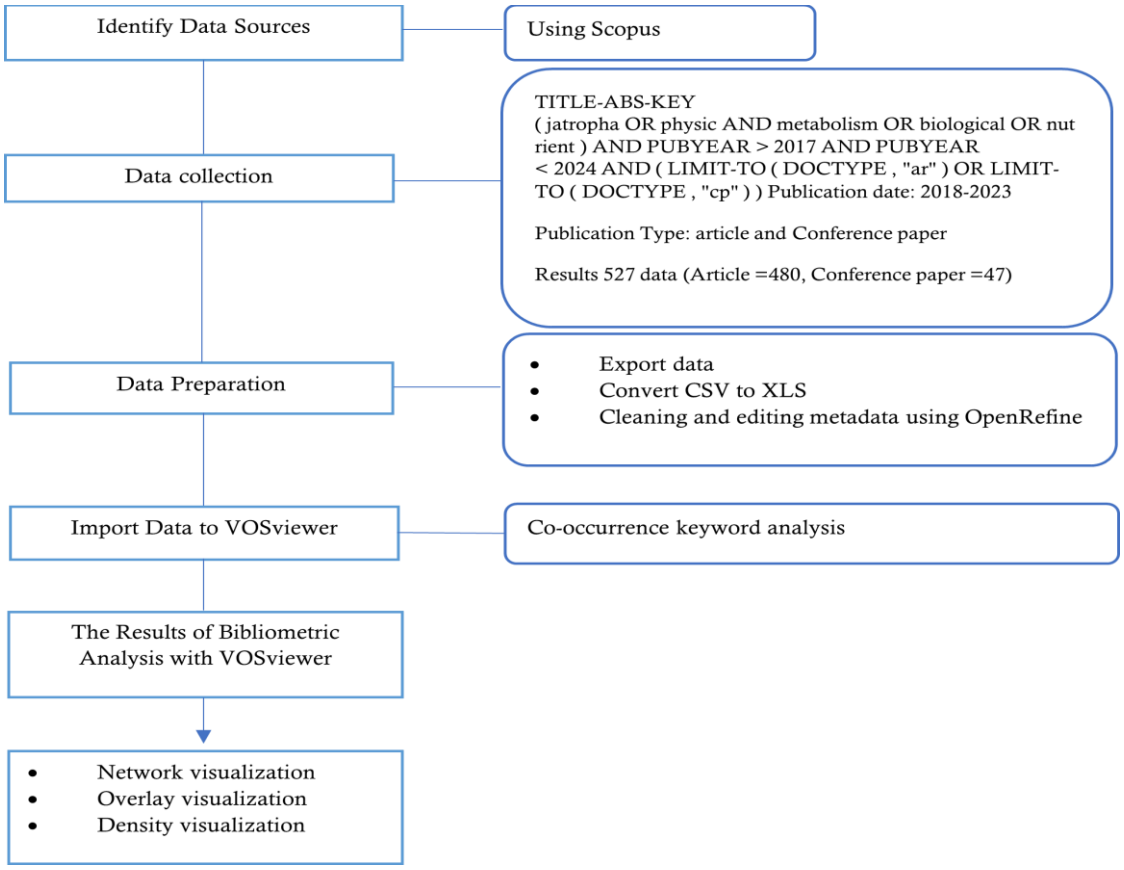

Figure 1. Researh Methods

Results

The VOSviewer software is utilized for bibliometric analysis. This program is capable of handling large amounts of data and provides visually appealing and communicative data visualization facilities, along with data analysis and investigation capabilities. Furthermore, VOSviewer can generate maps of publishers, authors, and journals based on co-citation networks and display keyword maps based on shared networks[7].

Table 1. The top 10 keywords with the most occurrences related to that topic

Keyword	Occurrences	Total Link Strength
Jatropha curcas	54	16
Abiotic stress	8	1
Detoxification	6	6
Phorbol esters	9	6
Chitosan	7	4
Anti-inflammatory activity	3	5
Antibacterial activity	6	6
Antioxidant	5	2
Flavonoids	4	4
Diterpenes	3	2

The extract from *Jatropha curcas* has been proven to exhibit antibacterial activity against various bacteria, including Staphylococcus aureus and Escherichia coli. The trend in this development can be observed in Table 1 regarding interrelated keywords with *Jatropha curcas*. The activity of this *Jatropha curcas* extract is presumed to be due to the presence of chitosan, a biopolymer found in the skin of *Jatropha curcas*. Chitosan has been proven to possess antibacterial properties by disrupting the bacterial cell membrane. Molecular docking studies have also been employed to investigate the potential of *Jatropha curcas* compounds to

interact with cancer cells. These studies have indicated that some *Jatropha curcas* compounds can bind to specific targets on cancer cells, potentially leading to the development of new cancer therapies [8,9].

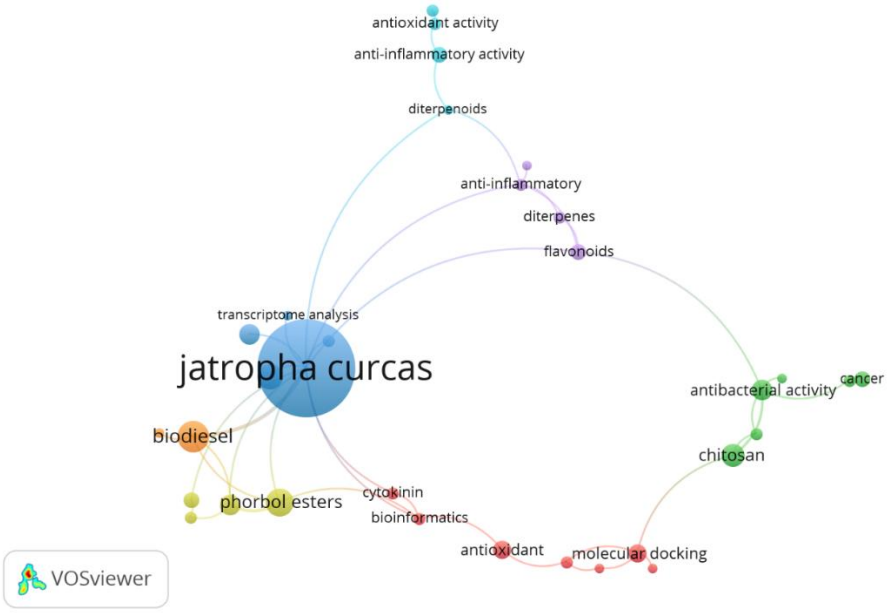

Figure 2. Network visualization of co-occurrence based on keywords

Network analysis can aid in understanding the roles of individuals within collaborative networks. In Figure 2, with the assistance of network visualization, one can also identify clusters or scientific communities within the network. The different colors of connecting lines in the above image indicate the relationships between clusters and the *Jatropha curcas* topic.

From the bibliometric analysis results using VOSviewer with the keyword "*Jatropha curcas* antioxidant", it can be broadly concluded that there are 7 clusters with 32 keyword items (as seen in Table 2). Keywords in cluster 1 have the highest number of links and total link strength compared to other clusters. The size of the circles indicates the number of publications related to that term, both in the titles and abstracts of articles. The larger the circle, the more articles are relevant to that keyword or term.

Table 2. Cluster relationships and connections among research topics

Cluster	Item
Cluster 1	Antibacterial, antioxidant, bioinformatics, curcin, cytokinin, metabolite profiling, molecular docking
Cluster 2	antibacterial activity, biosynthesis, cancer, chitosan, lipopeptide, wound healing
Cluster 3	abiotic stress, biological control, *Jatropha curcas*, nitrogen transcriptome analysis
Cluster 4	Detoxification, jatropha oil, phorbol esters, response surface methodology
Cluster 5	anti-inflammatory, curcumin, diterpenes, flavonoids
Cluster 6	anti-inflammatory activity, antioxidant activity, diterpenoids, phenolic compounds
Cluster 7	Biodiesel, nutrients

Nodes represent keywords, while node color indicates the year in which articles containing those keywords were published. The darker the color of the node, the earlier the topic discussed in that research was published, conversely, the brighter the color on the node, the more recent the topic in the research. Therefore, it can be interpreted that dark blue-colored keywords are those whose publication years are close to 2018, while light blue ones are close to 2019. Green nodes represent keywords published between 2020-2022. Meanwhile, yellow nodes represent the latest research topics, and the brighter the color, the closer the

publication year is to 2023. Visualization overlay in 2020 showed many studies on *Jatropha curcas*, including anti-inflammatory activity, antioxidant activity, diterpenoids, and phenolic compounds.

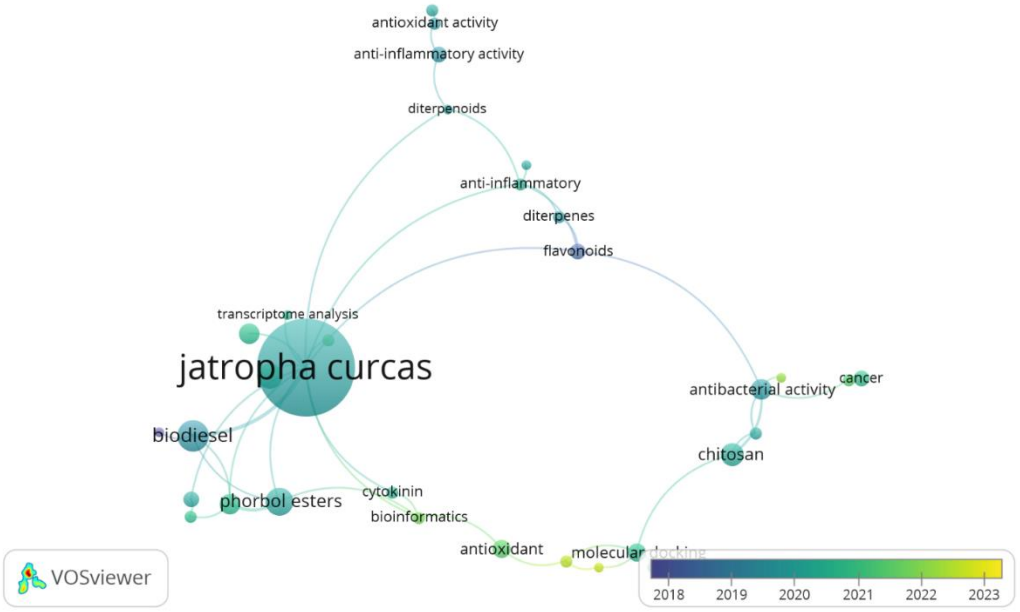

Figure 3. Overlay Visualization

Visualization overlay can also include a time-series analysis to understand the development of research trends over time. In the bibliometric analysis of *Jatropha curcas*, it was found that there is one color range, which is light blue, identifying research conducted in the range of the year 2018. In Figure 3, the visualization overlay shows that research conducted over a longer period appears with darker colors, while research conducted more recently is displayed with brighter colors. By using visualization overlay, researchers can observe the progress of research in a field and identify areas of research that are still scarce or have been extensively explored.

The Scopus Annual Publications from 2018-2023 is a comprehensive document reporting on research productivity worldwide during that period based on search keywords related to the nutritional potential of *Jatropha curcas* on body metabolism. This report is based on data from the Scopus database, one of the largest bibliographic and citation databases globally. In the last 6 years, research related to the potential of *Jatropha curcas* has shown development starting in 2018 with 112 publications (can be seen in Figure 4). This report can be used by researchers, policymakers, and other stakeholders to understand the latest developments in research and identify opportunities to enhance research productivity.

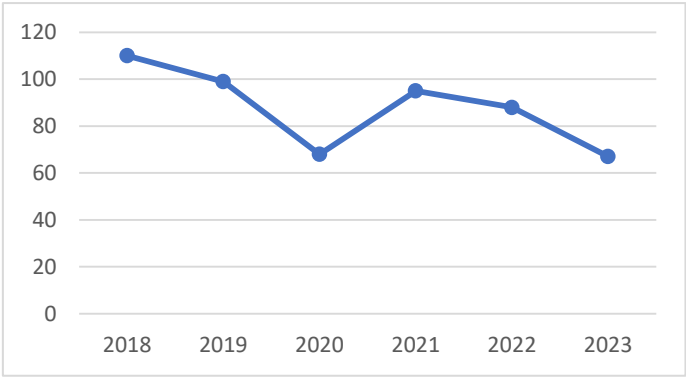

Figure 4. Annual publication based on year ranges from the scopus database

On Figure 5, the density level is illustrated by the number of frequently appearing keywords, marked with yellow color. *Jatropha curcas* has not been extensively researched, indicating a research gap in onomastic studies. This suggests ample opportunities for further research in this area.

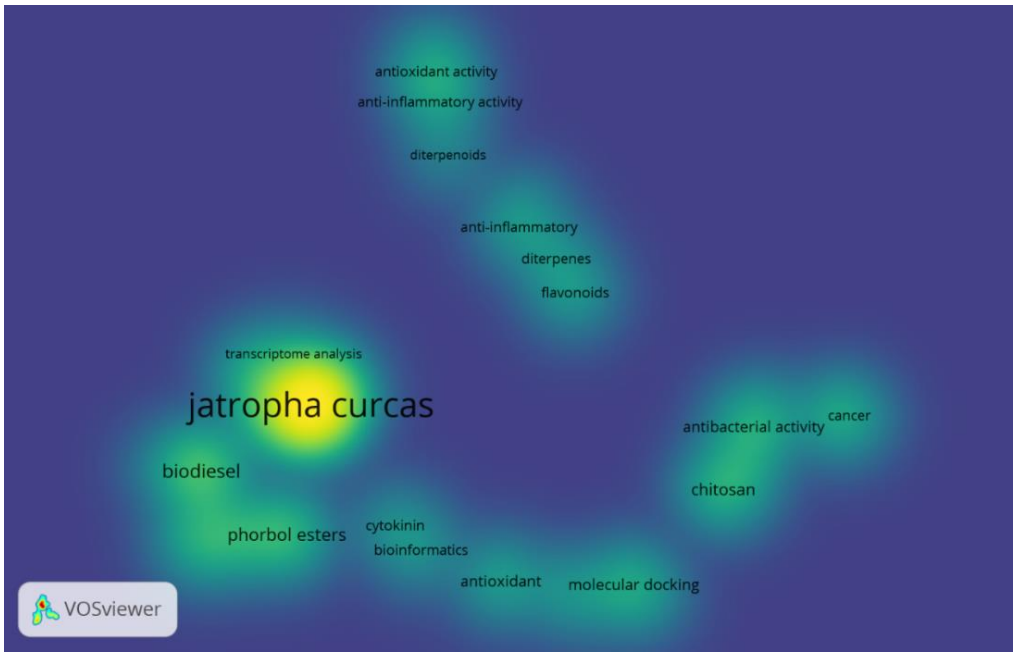

Figure 5. Density Visualization

The bibliometric results in the density visualization of *Jatropha curcas* show that it has not been widely studied. Therefore, there is an opportunity for research as the topic remains less explored. Researching topics with limited exploration provides an opportunity to contribute new and valuable insights to the field of science. It also allows researchers to think innovatively and creatively, resulting in a positive impact across various domains, including science, technology, health, and the environment.

In the visualization of item density, indicated by color changes representing the level of item density, the sequence is from blue to green to yellow. The more numerous and significant the items, the color tends to become more yellow. Conversely, the fewer and less significant the items, the color will tend more towards blue or green. By using VOSviewer, visualization technology allows us to observe the distribution of research and knowledge. Nodes with a yellow color indicate that a particular item has been a frequently recurring theme in previous journal publications. Therefore, when selecting a research topic, it is advisable to choose a topic with low-density visualization[10].

Discussions

Jatropha curcas is used as a medicinal plant in Africa, Asia, and Latin America to treat various diseases. Each part of *Jatropha curcas* has natural health benefits. The root of *Jatropha curcas* can treat gonorrhea, diarrhea, and rheumatism. Its latex is used as a remedy for toothaches, to stop bleeding, promote wound healing, and as an anticancer agent. The oil from *Jatropha curcas* leaves is employed to treat digestive and skin diseases, while the stem is used to control blood sugar. *Jatropha curcas* oil is also effective in treating dysentery and skin diseases[11].

Throughout the entire *Jatropha curcas* plant, from the roots to the leaves, there are chemical compounds or secondary metabolites. The stem of the *Jatropha curcas* plant contains saponins, flavonoids, tannins, and polyphenols. The leaves also contain various chemicals such as rutin, isoquercetin, quercetin, kaempferol, and kaempferol-3-rutinoside. Additionally, it contains ricin, astragalin, reiniutrin, and vitamin C [12].

Traditional medicine utilizing plants like *Jatropha curcas* is known as traditional medicine with various benefits. The seeds serve as a remedy for fungi, itching, wound infections, and swelling. The stalk is beneficial for treating vaginal discharge, ear inflammation, toothache, and mouth sores. Meanwhile, the leaves are used for rheumatism, pinworms in children, bloating, and constipation[13]. In addition to its benefits for metabolism, *Jatropha curcas* also serves another function as non-edible oil that can be used to produce biodiesel, a renewable alternative to fossil fuels. However, *Jatropha curcas* oil contains phorbol esters, which are toxic compounds that can irritate the skin and eyes.

Jatropha curcas contains phenolic compounds, which act as antioxidants. Antioxidants are molecules that can neutralize free radicals. Free radicals are unstable molecules that can damage cells and DNA. Antioxidants can help protect cells from damage and may reduce the risk of chronic diseases such as cancer and heart disease. *Jatropha curcas* is a plant with various health benefits. It is a source of phytochemicals with anti-inflammatory, antimicrobial, and antioxidant properties. These properties make *Jatropha curcas* a potential treatment for various health conditions[14,15].

Jatropha curcas contains numerous bioactive compounds, such as curcin, cytokinin, chitosan, lipopeptide, phorbol esters, diterpenoids, and phenolic compounds. The bioactive compounds in *Jatropha curcas* have various potential health benefits, including the ability to enhance metabolism. The phenolic compound curcumin, known for its antioxidant, anti-inflammatory, and anticancer properties, can boost metabolism by improving insulin sensitivity and reducing blood sugar levels[16,17].

Compound terpenoids and steroids are toxic to fungi. Terpenoids can disrupt lipid formation processes and alter cell membrane structures, while steroids can interact with phospholipid membranes. As a result, the growth and development of fungal spores are inhibited until fungal cells lyse [18]. Terpenoid compounds and diterpenes are closely related to the *Jatropha curcas* (L.) plant. This plant contains secondary metabolite compounds, including terpenoid compounds, which are generally accumulated in cells or secretory channels.

Plant hormones known as cytokinins are responsible for plant growth and development and have the ability to enhance plant metabolism by increasing protein synthesis and carbohydrate metabolism. Chitosan is a polysaccharide with antioxidant, anti-inflammatory, and anticancer properties. Additionally, chitosan has the ability to boost metabolism by improving nutrient absorption and fat metabolism.

Lipid membranes are protected from harmful activities by flavonoids, shielding them from hydroxyl radicals and superoxide. Flavonoids possess antioxidant properties, making them beneficial active plant components in traditional medicine to treat various conditions [19]. Lipopeptides, a combination of peptides and lipids, have antioxidant, anti-inflammatory, and anticancer properties. They can also enhance metabolism by increasing protein synthesis and carbohydrate metabolism. Phorbol esters have the ability to stimulate cell growth. They achieve this by increasing metabolism through enhanced protein synthesis and carbohydrate metabolism.

Methods that can be used to study the potential of *Jatropha curcas* in enhancing metabolism include Metabolism profiling, which is an analytical method used to study metabolism. Metabolites produced by *Jatropha curcas* after being consumed by humans can be studied using this method. Molecular docking is a computational method used to predict interactions between molecules. It can be employed to predict how bioactive compounds and molecular targets in the body interact within *Jatropha curcas*. To understand the relationship between several factors and the response of a process, Response Surface Methodology (RSM) is a statistical technique. This technique can be used to optimize the content of bioactive compounds in *Jatropha curcas* that have the potential to enhance metabolism.

Conclusions

This research attempts to outline the theme of *Jatropha curcas* for health, where there are 7 clusters with 32 items. Keywords in cluster 1 have the highest number of links and total link strength compared to other clusters. The size of the circles indicates the number of publications related to those terms, both in the titles and abstracts of articles. The results of the overlay visualization in 2021 showed that many studies were

conducted on *Jatropha curcas*, including one on *Jatropha curcas*, which has not been extensively researched, providing a wide opportunity for further research on this topic.

Declarations of competing interest

No conflict of interest

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