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Agricultural Potential of Yellow Pumpkin (*Cucurbita moschata* Duch.) as a Sustainable Horticultural Commodity: A Bibliometric Review of Global Data

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A B S T R A C T

Pumpkin is one of the agricultural commodities with potential as a functional food ingredient, supported by its nutritional value and availability. Many studies have been conducted on pumpkin, including its nutritional composition, bioactive carotenoid compounds, sustainable agricultural cultivation, waste management, and utilisation as a functional food. However, a bibliometric analysis of the agricultural potential of pumpkin has never been conducted. This study aims to map research trends on pumpkin and its potential as an agricultural commodity in the last 25 years (2000-2025). Research data were obtained from the ScienceDirect database and visualised using VOSviewer. The data visualisation showed that pumpkin is closely related to carotenoids, its main bioactive compounds. In addition, pumpkin has been associated with grafting techniques widely used in cucurbitaceae, especially in cucumber and watermelon. The most recent research on pumpkin focuses on pumpkin analogue rice, sensory analysis, and metabolomics. By visualizing the agricultural potential of pumpkin, the trend and development over time can be clearly seen. This visualisation can serve as a reference for researchers to identify the research gap in pumpkin and its future potential.

Contribution to Sustainable Development Goals (SDGs):
SDG 3 (Good Health and Well-Being)
SDG 12 (Responsible Consumption and Production)
SDG 17 (Partnerships for the Goals)

1. INTRODUCTION

1.1. Research Background

Indonesia is an agricultural country, where Pumpkins (Cucurbita spp.) are among the most widely cultivated plants in the gourd family worldwide, with Cucurbita moschata among the main species due to its adaptability to the environment and high nutritional value [1]. The genus Cucurbita is native to the Americas and consists of about 15 species, five of which have been domesticated: *C. pepo, C. maxima, C. moschata, C. argyrosperma*, and *C. ficifolia* [2]. Among the gourd crop species, C. moschata has high agronomic value due to its strong environmental tolerance and postharvest stability. This species grows very well in tropical and subtropical climates, thus showing heat resistance in addition to natural resistance to diseases and pests. *C. moschata,* with its adaptive properties, is widely cultivated in areas that have extreme environments [3].

In Indonesia, pumpkin is dominated by *C. moschata* and *C. maxima*. The *C. moschata* variety is more commonly found due to its resistance to humid tropical conditions, so its presence is relatively abundant. Pumpkin is an agricultural commodity that is readily accessible to the community and can be processed into local food products. Pumpkin plants can grow in lowlands and highlands, making them suitable for West Sumatra, especially in

the Solok, Agam, and Tanah Datar districts, which have large pumpkin production [4][5].

Various previous studies have examined pumpkin from various aspects, ranging from cultivation techniques and post-harvest technology to its nutritional content and the utilisation of pumpkin waste. However, no study has comprehensively analysed the development of pumpkin's agricultural potential using a bibliometric approach. Bibliometric analysis is a quantitative approach widely used to evaluate the development of scientific literature comprehensively. This technique facilitates the identification of research trends, collaboration patterns, and relationships among concepts by exploring indicators such as citation profiles, author networks, and distributions of key terminology. Furthermore, this method enables mapping scientific developments based on temporal, geographical, and institutional parameters, including the analysis of publication performance using various indexing and scoring systems [6].

1.2. Research Objective

This study aims to map the development of research on the agricultural potential of pumpkin through bibliometric analysis and to identify opportunities for future research development. Using a quantitative approach, this study is expected to provide an overview of research trends, research gaps, and recommendations that can be used as a reference for the development of the agricultural potential of pumpkin commodities.

2. MATERIALS AND METHODS

2.1. Data collection

References on the agricultural potential of pumpkin were sourced from the Scopus database, which provides more comprehensive data. Scopus databases were searched using the keywords "pumpkin" and "Cucurbita moschata", and "agricultural potential". The scientific literature searched included one or more keywords, terms, or phrases in the title, abstract, article, or keywords, specifically in research articles. The scientific literature used was from the last 25 years (2000-2025) and included only English-language publications. The total number of titles and abstracts found in the database search was 343. Duplicate articles were managed using Mendeley software through recording, monitoring, sorting, and checking studies, resulting in a total of 95 duplicate sets eliminated from the list.

2.2. Data extraction and analysis

Data extraction and analysis are performed by collecting information from the existing scientific literature, including titles, abstracts, and keywords of relevant articles. After data extraction, the data are analysed to understand them. The collected literature was saved in ".RIS" format. The data were then exported to Vosviewer 1.6.19 for bibliometric analysis [7]. The parameters used include publication trends over 25 years, analysis of journals that contribute to scientific publications, a keywords co-occurrence network, and a keywords overlay network by year. The data extraction and analysis process is shown in Fig. 1.

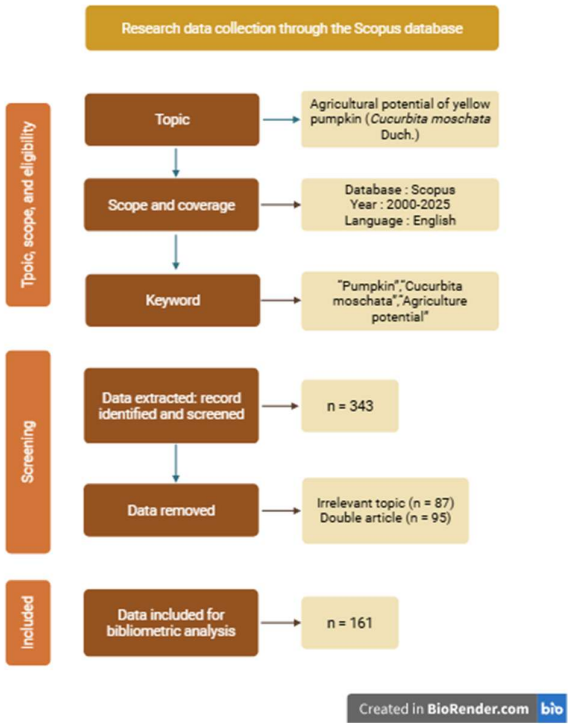

Figure 1. Flowchart of literature collection

2.3. Term maps

VOSviewer is software that analyses and visualises bibliometric data from a database of words extracted from the titles, abstracts, and keywords of selected literature. The data visualisation is a bubble map, with each bubble representing a word or phrase from the literature. The size of the bubble represents the number of citations per publication containing that word. How often two words appear together is indicated by the distance between two bubbles [8].

3. RESULT AND DISCUSSION

3.1. Publication trends

Based on a bibliometric study of the potential of pumpkin agriculture over a 25-year period, it was found that the research trend increased year by year (see Fig. 2). The most publications in the 25 years occurred in 2023. Based on the literature collected, in that year research on the agricultural potential of pumpkin focused on the development of functional foods based on carotenoid and flavonoid compounds, plant breeding through genetic approaches, food safety, and the utilisation of pumpkin waste to produce value-added products. The publication trend of pumpkin topics and its relationship with agricultural potential shows the strategic role of pumpkin commodities in supporting agriculture in a sustainable manner.

Many publications on pumpkin's agricultural potential appear in journals focused on sustainable agricultural commodities. The top three journals that most frequently publish articles related to pumpkin's agricultural potential are Scientia Horticulturae, Plant Physiology and Biochemistry, and Journal of Food Composition

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and Analysis (see Table 1). These three journals are known to have published many papers on fresh horticultural crops with economic value (fruits, vegetables, and mushrooms), plant breeding, sustainable agricultural systems, and omics approaches integrated with plant physiology.

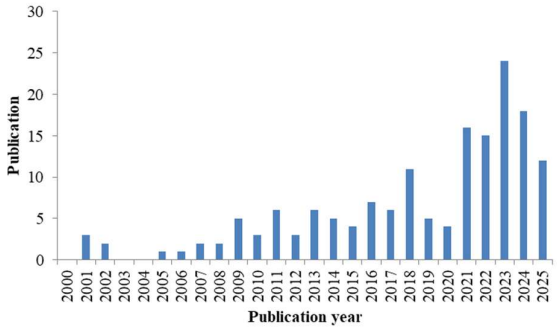

Figure 2. Publication trends of pumpkin's agricultural potential in the last 25 years

Table 1. Top contributors journal

No.	Journal	Publication
1.	*Scientia Horticulturae*	15
2.	*Plant Physiology and Biochemistry*	8
3.	*Journal of Food Composition and Analysis*	8

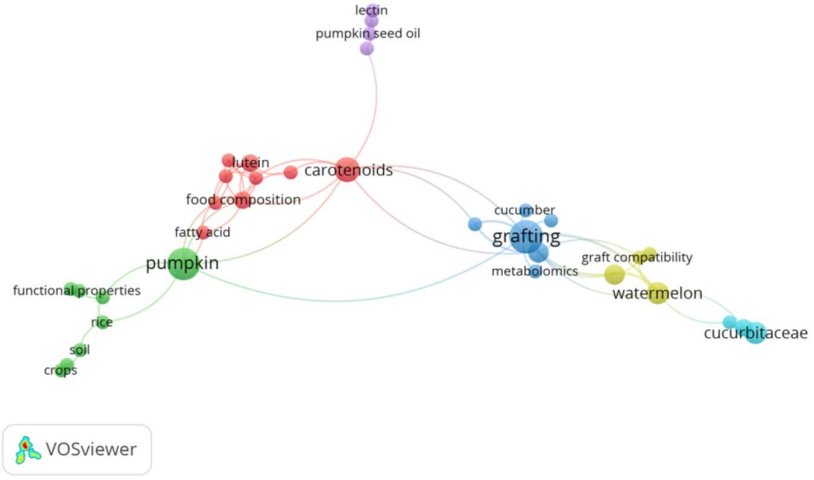

Figure 3. Keyword co-occurrence network

In Fig. 3, the distribution map of pumpkin keywords by agricultural potential shows several groups. The bubble map shows the relationships between the keyword 'pumpkin' and other related keywords. Some keywords have larger bubble maps than others, namely pumpkin, carotenoids, grafting, watermelon, and cucurbitaceae. The large size of the bubble map indicates that extensive research has been conducted on these keywords. The dominant keywords are pumpkin and carotenoids, indicating that pumpkin research is developing toward utilisation as a functional food but has not been much explored in terms of agronomic sustainability.

The keyword relationship of pumpkin is with carotenoids, the main bioactive compounds found in pumpkins. Pumpkins (*Cucurbita* spp.) are a source of carotenoids in foods, with concentrations varying widely by species. Pumpkin variety *C. moschata* is rich in β-carotene and α-carotene, while *C. The pepo* variety contains mainly lutein and β-carotene. *C. maxima* pumpkin shows different patterns among pumpkin types, with violaxanthin as the primary carotenoid [9]. This difference in carotenoid content across pumpkin types demonstrates the diversity of pumpkin types. Pumpkin commodities can be processed into highly nutritious and health-beneficial foods.

In addition, the bioactive carotenoid compounds in the bubble map are interlinked with the keywords food composition and fatty acids, indicating that bioactive compounds in pumpkin have been widely studied in the food field. Pumpkin is also related to its functional properties. The functional properties of pumpkin are related to the antioxidants and dietary fiber contained in pumpkin. Pumpkin seeds have also been widely studied in relation to pumpkin seed oil and lectin compounds [10].

Furthermore, pumpkin has also been studied in relation to grafting. Grafting is a commonly used horticultural technique to minimise damage from soil-borne diseases and enhance plants' ability to withstand stress, ultimately increasing crop productivity [11]. Pumpkin grafting is widely used in the cucurbitaceae family, including cucumber and watermelon. The visualisation of

keyword mapping related to the agricultural potential of pumpkin clearly shows which research trends have been carried out and their interrelationships, enabling them to be developed for future research.

3.2. Keyword overlay network

Keyword overlay mapping shows year-over-year research trends. Increasingly yellow bubble map colours indicate that research on the keyword is ongoing and likely to be pursued further. Conversely, purple bubble maps indicate research has been conducted for a long time. The keyword overlay network for pumpkin agricultural potential is shown in Figure 4.

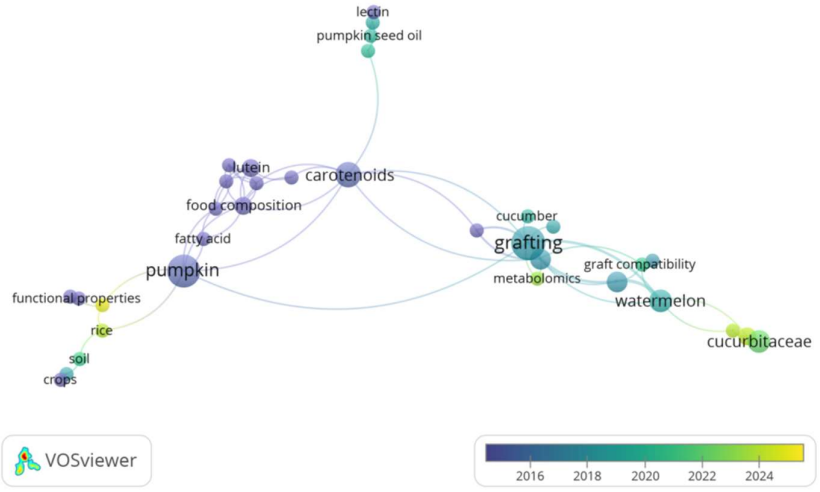

Figure 4. Keyword overlay network

The bubble map shows that research on pumpkin, carotenoids, food composition, fatty acids, etc., has been conducted from 2000 to early 2016. Meanwhile, research on grafting techniques has a turquoise bubble map colour, indicating that this research began in 2018 and continued through early 2022. Furthermore, pumpkin research related to rice, sensory, and metabolomics on the bubble map is coloured yellow and ranges from 2024 to 2025. The yellow colour indicates that this research still has significant room for further development.

4. CONCLUSION

The results of a bibliometric analysis of the agricultural potential of pumpkin indicate that research trends have been increasing each year. The potential of pumpkin as a functional food ingredient stems from its high carotenoid content, a natural antioxidant compound. The grafting technique on pumpkin is also widely applied to plants from the cucurbitaceae family such as watermelon and cucumber. Recent research on the agricultural potential of pumpkin includes pumpkin analogue rice, sensory research, and metabolomic approaches. The most-cited journal on pumpkin is Scientia Horticulturae, with 15 publications in the last 25 years. Mapping with VOSviewer can provide researchers with insight into pumpkin's agricultural potential and future research directions.

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