Research Trends of Banana Flour: A Bibliometric and Visualization Analysis

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Abstract. Banana flour is a highly nutritious product derived from the banana fruit. Over the past decade, research on banana flour has significantly increased. To better understand the research surrounding this trend, this study conducted a bibliometric and visualization analysis of the dataset from the Scopus database. This study aimed to evaluate the research output related to banana flour research, focusing on factors such as country, institution, journal, and author participation. The results showed that 455 documents were successfully retrieved, with 2023 being the year with the most publications (76 documents). During the observation period, research articles (82.6%) dominated banana flour research, with Agricultural and Biological Science being the leading subject area (32.6%). Desnilasari, D. and Ekafitri R. are outstanding researchers who have contributed significantly to banana flour research in the last decade, with ten documents each. The most significant affiliations and countries contributing globally to this subject were Universitas Padjajaran and Indonesia. The IOP Conference Series: Earth and Environmental Science and Food Research were the most popular conference proceedings and journals for publishing research on banana flour. A total of 1144 co-occurrences of the author's keyword related to banana flour research were found, with "resistant starch" being the top, which appeared in 54 occurrences with a total link strength of 81. The similarity index and relevance clustered all keywords into five groups.

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1 Introduction

Banana is a popular fruit consumed globally by people of various ages and backgrounds, both in its fresh form and in various dried and processed products [1]. These fruits originate from South and Southeast Asia [2] and are abundantly cultivated in Indonesia in yards and extensive banana plantations. Banana fruit boasts an abundance of phytochemical compounds, such as flavonoids, phenolic acids, catecholamines, and terpenoids. Additionally, it is a rich source of essential minerals such as potassium, phosphorus, and magnesium. Furthermore, bananas are packed with complete vitamins, such as vitamins A, C, and B complex (B6 and B12) [3]. Additionally, fresh banana production in Indonesia is relatively high, with varying varieties in each region. According to Indonesian Statistics Agency (BPS) reports, the production of banana fruits in Indonesia reached 9596972 tons in 2022, an increase of approximately 10% from previous periods [4]. As banana fruit production continues to rise, it is essential to implement proper post-harvest handling practices because fresh banana fruits are perishable with high moisture content and a relatively short storage period. This makes them susceptible to spoilage during handling, transportation, and storage [5] – [6].

Fresh banana fruit is transformed and processed into banana flour to preserve its nutritional composition and improve its storage period [7]. Derived from fresh banana fruit, banana flour is rich in functional components, such as highly resistant starch, dietary fiber, and minerals. Banana flour is a gluten-free flour with low processing costs and versatility, making it an excellent alternative to wheat flour for gluten-free products [6]. The food industry commonly employs banana flour to create various products including pasta, biscuits, cakes, cookies, bread, and baby foods [3], [8] – [9].

Since research on banana flour has advanced rapidly in recent years, both in processing and its modifications, it is vital to maintain and improve the quality of banana flour and its modification products by considering research issues and trends. Data from scientific research activities must be reliable and readily available to assess research findings. Therefore, data gathered from scientific research must be trustworthy and easily accessible to evaluate research findings. Bibliographic studies are popular statistical methods used to evaluate research findings, explore the connections between them, map scientific fields, and predict further research in specific fields [10] – [13]. Therefore, this study aimed to perform a bibliometric analysis of banana flour research to identify potential future research areas, including looking into processing and modification methods that can be used to produce banana flour with specific characteristics suitable for various applications, both in the food and non-food sectors.

2 Methods

2.1 Data Collection

The data for the bibliometric analysis of banana flour in this study were retrieved from the Scopus database as described by Tirado-Kulieva et al. [14]. The range of papers used in this study was from January 1, 2014, to March 30, 2024, with the string code as follows: TITLE-ABS-KEY (banana AND flour) AND (pasting AND properties) OR (modification) OR (nutritional) AND PUBYEAR > 2013 AND PUBYEAR < 2025.

2.2 Bibliometric Analysis

The dataset containing the specific string code described in Section 2.1 was exported from the Scopus database to a CSV Microsoft Excel format extension for further analysis. To examine the co-occurrence of the most used keywords in the dataset, VOSviewer software 1.6.17 version from Leiden University, the Netherlands, was used for bibliometric analysis, as referenced by George et al. [15]. In addition, this analysis provides extensive information on annual publications, subject areas, authors, countries, organizations, and journals related to banana flour during the observed times, which have been comprehensively studied [14].

3 Results and Discussions

3.1 Annual Publication Trends, Type of Papers, and Research Subject Area Contribution to Banana Flour Research

From January 1, 2014, to March 30, 2024, 456 documents were successfully retrieved from the Scopus database. The trends in banana flour research increased from 2014 to 2016, followed by a few decreases in 2017. From 2017 to 2021, publication trends increased significantly. However, the annual publication of banana flour declined in 2022 compared to earlier studies. The following year, the annual banana flour reached 76 publications, with the highest number of annual publications since 2014. Moreover, as of March 30, 2024, 20 papers had been published at the beginning of the year. The annual publication of banana flour is shown in Fig. 1. The increase in banana flour research during the observation period might be related to its nutritional potential and applications across disciplines. Based on its nutritional content, banana flour is rich in resistant starch, dietary fiber, potassium, magnesium, and various bioactive compounds with beneficial health effects [16] – [21]. Moreover, banana flour has a wide range of applications, such as food fortification and functional food ingredients [17], [21] – [24], coating materials [25] – [26], phytomedicine [19], [27], and functional feed [28] – [29]. Research on banana flour has been steadily increasing during the observation period, likely because of its nutritional potential and diverse applications across various fields. Nutritionally, banana flour is rich in resistant starch, dietary fiber, potassium, magnesium, and a range of bioactive compounds that offer health benefits [16] – [21]. Moreover, banana flour has a wide array of applications, including food fortification, as an

ingredient in functional foods [17], [21] – [24], as coating materials [25] – [26], in phytomedicine [19], [27], as a functional feed ingredient [28] – [29], and in other significant applications.

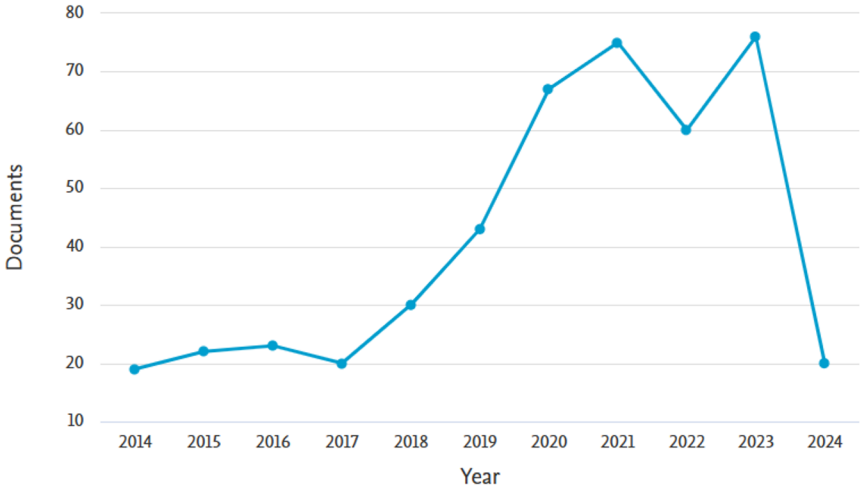
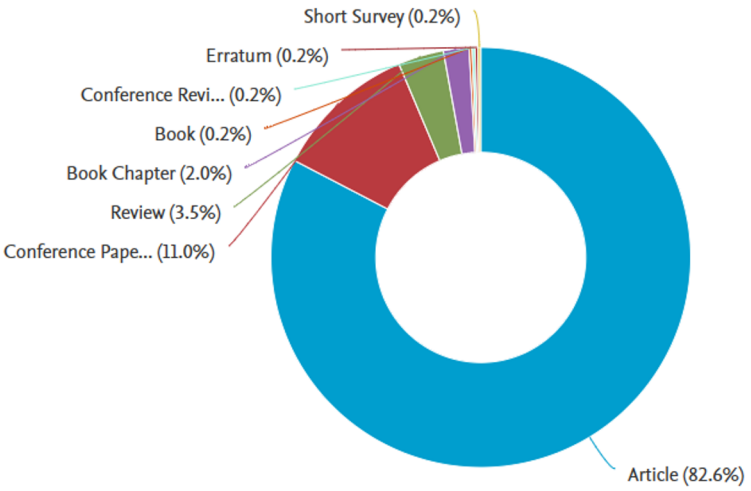
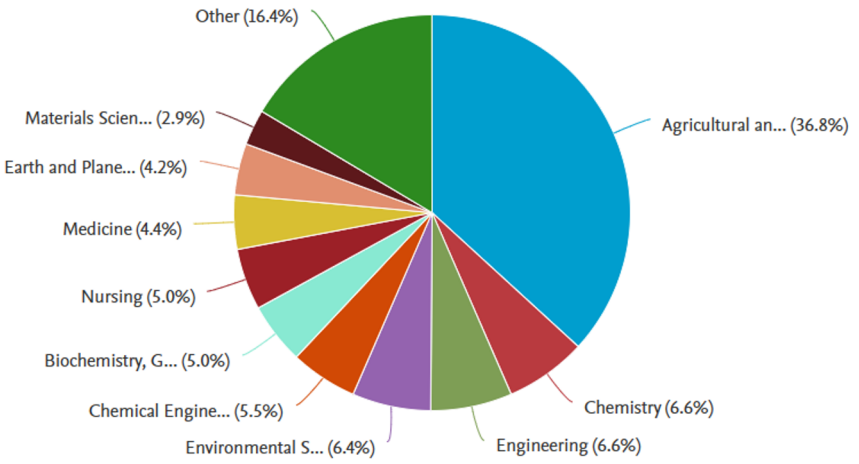


Fig. 1. The annual publication of banana flour research

Of the 455 documents retrieved from the Scopus database, most were articles, accounting for 82.6% (376 documents). Conference papers followed this at 11% (50 documents), review articles at 3.5% (16 documents), and book chapters at 2.0% (nine documents). The remaining document types, including books, conference reviews, errata, and short surveys, comprised only 0.2% (one document) of the documents, as shown in Fig. 2A. Based on the research subject area in Fig. 2B, agricultural and biological science was the top subject that produced research output on banana flour with 316 documents (36.8%). In addition, banana flour research is also interesting, published in journals with Chemistry and Engineering subjects, with 57 documents (6.6%) each, followed by Environmental Science subject (6,4%), chemical engineering subjects (5.5%), biochemistry, genetic and molecular biology, nursing subjects (5.0% of each), medicine subjects (4.4%), earth and planetary sciences (4.2%), material sciences subjects (2.9%), and the rest published in journals with various subjects.



(A)



(B)

Fig. 2. The composition of papers on banana flour research based on the document type (A) and the research subject area (B)

3.2 Author, Affiliation, Country, and Journal Contribution to Banana Flour Research

The famous authors' contributions to banana flour research worldwide during the observation period were Deslinasari, D. and Ekafitri, R., who published ten articles each (Table 1). Deslinasari, D. and Ekafitri, R. in a recent study, conducted the formula optimization of the plantain var. kapas flour and wheat flour are used by the D-optimal methods to produce soft cakes with low gluten content that all society can consume [16]. In addition, the authors with the most popular article citations were Sarawong et al. [17] with 226 citations. Sarawong and colleagues studied the cooking extrusion parameters (feed moisture and screen speed) and extruded green banana flour storage at 4°C for 24 hours. They found that the cooking parameters and storage treatment resulted in significant changes in various parameters, including water absorption index, water solubility index, pasting properties, amylose content, resistant starch, total dietary fiber, insoluble dietary fiber, total phenolic content, and antioxidant activities (FRAP, ABTS, and DPPH of free phenolics) of the extruded green banana flour.

As shown in Table 1, Universitas Padjajaran in Indonesia has published the highest number of globally recognized articles related to banana flour, totaling 12 papers. Other Indonesian institutions, including Badan Riset dan Inovasi Nasional and Lembaga Ilmu Pengetahuan Indonesia, also rank in the top 10 for most affiliations. The Instituto Politecnico Nacional, a Mexican institution, is also notable for its ten documents related to banana flour. Among Latin American institutions and universities, those in Brazil, such as Universidade de Sao Paulo, Universidade Federal de Lavras, Universidade Federal de Vicosa, and Universidade Estadual Paulista Julio de Mesquita Filho, are the most affiliated with banana flour research (Table 1). Additionally, the University of Venda in South Africa produced the most articles on banana flour in the African continent. Indonesia is the top country to contribute papers related to banana flour (84 documents) globally and Southeast Asia, followed by Brazil (76 documents) and India (57 papers) as the top 3. The high contribution of Indonesia to published articles related to banana flour was correlated with the high production of fresh banana flour, which was approximately 9596972 tons in 2022 [4].

On the other hand, the IOP Conference Series: Earth and Environmental Science was chosen as the top conference proceeding to publish articles related to banana flour, with 29 documents, followed by Food Research (18 documents), Journal of Food Science and Technology (16 documents), Foods (13 documents), and the International Food Research Journal with 12 documents to complete the top five journal and conference proceedings for publication articles related to banana flour. However, the number of publications in the top five journals or conference proceedings fluctuated every year, as illustrated in Fig. 3. The highest publication in the IOP Conference Series: Earth and Environmental Science was associated with multidisciplinary scopes and subject areas, including Earth and planetary sciences, environmental science, physics, and astronomy. Moreover, conference proceedings are published faster and more simply than reputable journals, providing researchers with an alternative to disseminate their research more quickly. Moreover, the other journal targets for published papers on banana flour were prestige, reputation, and high-impact factors in their subject research

area, and they are listed as Q1 to Q3 based on the Scimago Journal and Country Rank (SJR).

Table 1. The top authors, affiliation, and country contribution to banana flour research

Name of Author	Number of Paper	Name of Affiliation	Number of Paper	Country Name	Number of Paper
Desnilasari, D.	10	Universitas Padjajaran	12	Indonesia	84
Ekafitri, R.	10	Instituto Politecnico Nacional	10	Brazil	76
Brennan, C.S.	8	Universidade de Sao Paulo	9	India	57
Brennan, M.A.	8	Lincoln University	8	Thailand	35
Cahyana, Y.	8	Universidade Federal de Lavras	8	Nigeria	24
Rachman, A.	8	Badan Riset dan Inovasi Nasional	8	Malaysia	23
Surahman, D.N.	8	Universidade Federal de Vicosa	7	South Africa	20
Anyasi, T.A.	6	University of Venda	7	Mexico	19
Marta, H.	6	Lembaga Ilmu Pengetahuan Indonesia	7	United States	16
Morton, I.	6	Universidade Estadual Paulista Julio de Mesquita Filho	6	New Zealand	14

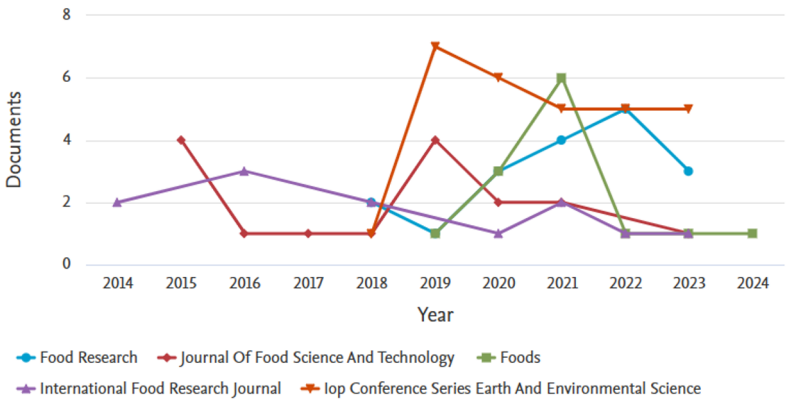


Fig. 3. The comparison of annual publications in the top 5 journal or conference proceedings related to banana flour research

3.3 Co-occurrence of keywords by authors contribution to banana flour research

The combination of keywords used by authors in their publications is known as co-occurrence of keywords. The authors used research keywords to enhance their visibility and make the search easier. These keywords indicate the current research trends in a particular subject. [15], [18], [19]. Fig. 4 illustrates that out of the 1144 keywords associated with banana flour in relation to the author's keywords, only 48 co-occurrences matched the requirement of at least five keywords. Table 2 lists “resistant starch” as the top keyword in this study, with a frequency of co-occurrence of 54. Other popular keywords and the co-occurrent were “banana flour” (40), “banana” (39), “green banana flour” (24), “flour” (23), “functional properties” (20), “sensory evaluation” (19), “green banana” (18), “pasting properties” (15), “unripe banana flour” (14), etc. The most frequently used keywords in these studies indicate that banana flour has been widely researched in various fields, including food science, agriculture, biology, biochemistry, chemical engineering, medicine, and related areas. This correlation strongly indicated the potential of banana flour as a valuable resource in these fields. Moreover, the popular keywords found in this study correlated with the processing, modification, and methods of analysis of banana flour and its modifications.

In the present study, the total link strength was 421 links, with the most prominent links being "resistant starch" with 81 links, similar to co-occurrence. The top five keywords were banana" with 54 links, "flour ‘with 43 links, "functional properties’ with 34 links, and "green banana flour" and "sensory evaluation" with 29 links each. The keywords were divided into five specific clusters based on their similarity index and relativity [15], as listed in Table 3.

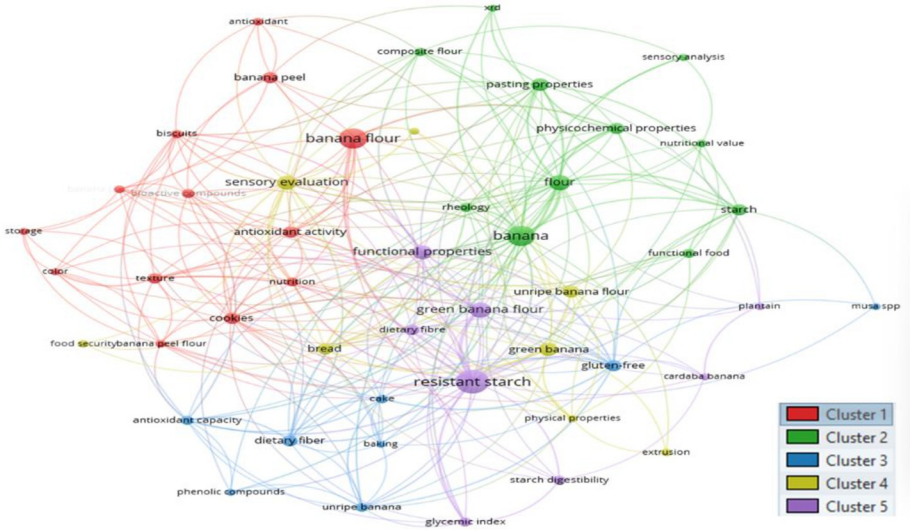


Fig. 4. The network overlay of the author’s keyword with a minimum of 5 co-occurrences in publications on banana flour research

Table 2. The top 10 keywords, occurrence, and total link strength on banana flour research

Keyword	Occurrence	Total Link strength
Resistant starch	54	81
Banana flour	40	25
Banana	39	54
Green banana flour	24	29
Flour	23	43
Functional properties	20	34
Sensory Evaluation	19	29
Green banana	18	20
Pasting properties	15	28
Unripe banana flour	14	15

Table 3. Cluster and major keywords

Cluster	Colour	Major keywords
1	Red	Antioxidant, Antioxidant activity, banana flour, banana peel flour, banana peel powder, bioactive compounds, biscuit, color, cookies, nutrition, storage, texture
2	Green	Banana, composite flour, flour, functional food, nutritional value, pasting properties, physicochemical properties, rheology, sensory analysis, starch, XRD
3	Blue	Antioxidant capacity, baking, cake, dietary fiber, gluten-free, *Musa* spp, phenolic compounds, unripe banana
4	Yellow	Bread, extrusion, food security, green banana, nutritional characteristics, physical properties, sensory evaluation, unripe banana flour
5	Purple	Cardaba banana, dietary fibre, functional properties, glycemic index, green banana, plantain, resistant starch, starch digestibility

Fig. 5 shows the density mapping overlay of keywords in banana flour research. Notably, the highest density was associated with resistant starch, banana flour, and banana. The density map employs a color-coded system with larger circles and a greater prevalence of yellow, indicating a higher density and frequency of a given keyword. Conversely, less frequent keywords tend to blend into the green background, resulting in a more faded color [20].

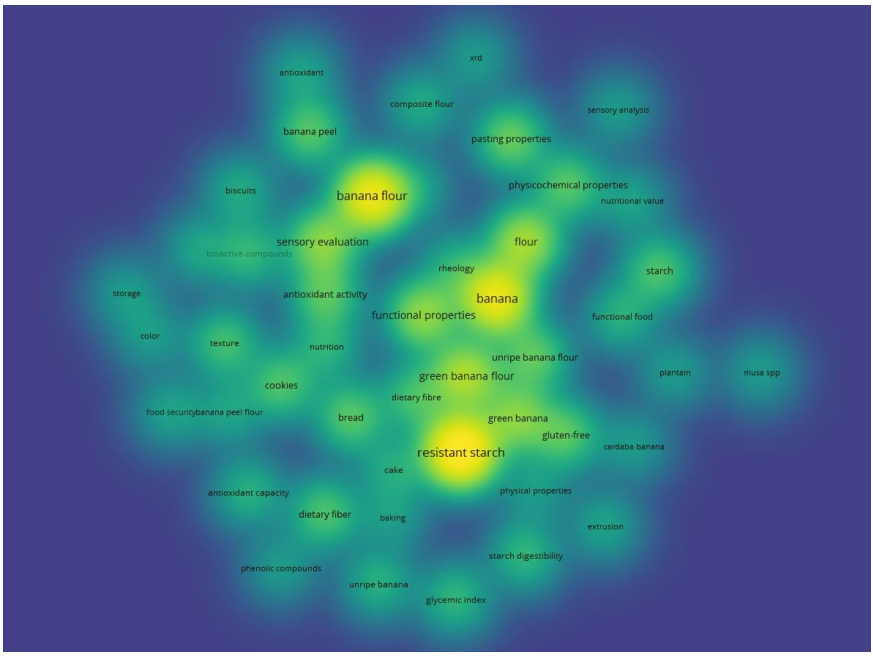


Fig. 5. The density overlay of banana flour research

4 Conclusion

The bibliometric and visualization analysis of banana flour research, spanning from January 1, 2014, to March 30, 2024, was completed. The Scopus database was used to retrieve 455 documents for analysis. The year with the most annual publications is 2023, with 76 documents. Our findings revealed that the article research type (82.6%) dominated banana flour research during the observation period, with Agricultural and Biological Science being the leading subject research area (32.6%). Desnilasari, D., and Ekafitri R. are the authors who have significantly contributed to banana flour research among other leading researchers globally in the last decade, with ten documents each. Regarding affiliation and country, Universitas Padjajaran and Indonesia made the most significant global contributions to banana flour research. The IOP Conference Series: Earth and Environmental Science and Food Research were the most popular conferences and journals on banana flour research. We identified 1144 co-occurrence keywords from author keywords related to banana flour research, with "resistant starch" being the most popular, with a co-occurrence of 54 and a total link strength of 81. All keywords were grouped into five clusters based on their similarity index and relativity.

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Disclosure of Interests. The authors declare that there are no conflicts of interest.

References

[1] M. Al-Dairi, P. B. Pathare, R. Al-Yahyai, H. Jayasuriya, and Z. Al-Attabi, "Postharvest quality, technologies, and strategies to reduce losses along the supply chain of banana: A review," *Trends Food Sci Technol*, vol. 134, pp. 177–191, Apr. 2023, doi: 10.1016/j.tifs.2023.03.003.

[2] H. Nadeeshani, G. Samarasinghe, R. Silva, D. Hunter, and T. Madhujith, "Proximate composition, fatty acid profile, vitamin and mineral content of selected banana varieties grown in Sri Lanka," *Journal of Food Composition and Analysis*, vol. 100, p. 103887, Jul. 2021, doi: 10.1016/j.jfca.2021.103887.

[3] K. H. Maseko, T. Regnier, B. Meiring, O. C. Wokadala, and T. A. Anyasi, "Musa species variation, production, and the application of its processed flour: A review," *Sci Hortic*, vol. 325, p. 112688, Feb. 2024, doi: 10.1016/j.scienta.2023.112688.

[4] BPS-Statistics Indonesia, *Statistical Yearbook of Indonesia 2023*. Jakarta: Directorate of Statistical Dissemination, 2023.

[5] L. Kaur, S. B. Dhull, P. Kumar, and A. Singh, "Banana starch: Properties, description, and modified variations - A review," *Int J Biol Macromol*, vol. 165, pp. 2096–2102, Dec. 2020, doi: 10.1016/j.ijbiomac.2020.10.058.

[6] L. Chang *et al.*, "Structural, physicochemical, antioxidant and in vitro digestibility properties of banana flours from different banana varieties (Musa spp.)," *Food Biosci*, vol. 47, p. 101624, Jun. 2022, doi: 10.1016/j.fbio.2022.101624.

[7] M. M. A. N. Ranjha, S. Irfan, M. Nadeem, and S. Mahmood, "A Comprehensive Review on Nutritional Value, Medicinal Uses, and Processing of Banana," *Food Reviews International*, vol. 38, no. 2, pp. 199–225, Feb. 2022, doi: 10.1080/87559129.2020.1725890.

[8] N. K. Amarasinghe, I. Wickramasinghe, I. Wijesekara, G. Thilakarathna, and S. T. Deyalage, "Functional, Physicochemical, and Antioxidant Properties of Flour and Cookies from Two Different Banana Varieties (Musa acuminata cv. Pisang awak and Musa acuminata cv. Red dacca)," *Int J Food Sci*, vol. 2021, pp. 1–9, Jun. 2021, doi: 10.1155/2021/6681687.

[9] R. Fida, G. Pramafisi, and Y. Cahyana, "Application of banana starch and banana flour in various food product: A review," *IOP Conf Ser Earth Environ Sci*, vol. 443, no. 1, p. 012057, Feb. 2020, doi: 10.1088/1755-1315/443/1/012057.

[10] N. Donthu, S. Kumar, D. Mukherjee, N. Pandey, and W. M. Lim, "How to conduct a bibliometric analysis: An overview and guidelines," *J Bus Res*, vol. 133, pp. 285–296, Sep. 2021, doi: 10.1016/j.jbusres.2021.04.070.

[11] J. E. Witoyo, E. Ni'maturohmah, and P. A. R. Utoro, "Recent Trends in Porang Research via Bibliometrics Analysis Approach," *Jurnal Ilmiah Universitas Batanghari Jambi*, vol. 23, no. 3, p. 2723, Oct. 2023, doi: 10.33087/jiubj.v23i3.3903.

[12] M. Akın, S. P. Eyduran, M. Papageorgiou, E. Bartkiene, and J. M. Rocha, "Bibliometric analysis on pseudocereals," *Cleaner and Circular Bioeconomy*, vol. 6, p. 100062, Dec. 2023, doi: 10.1016/j.clcb.2023.100062.

[13] P. A. R. Utoro and I. Rosadi, "Perkembangan Penelitian di Bidang Teknologi Membran Menggunakan Pendekatan Cellulose Acetate Mixed Matrix Membrane: Studi Analisis

Bibliometrik," *Jurnal Ilmiah Universitas Batanghari Jambi*, vol. 22, no. 3, p. 2201, Oct. 2022, doi: 10.33087/jiubj.v22i3.2705.

[14] V. A. Tirado-Kulieva, K. S. Gutiérrez-Valverde, M. Villegas-Yarlequé, E. W. Camacho-Orbegoso, and G. F. Villegas-Aguilar, "Research trends on mango by-products: a literature review with bibliometric analysis," *Journal of Food Measurement and Characterization*, vol. 16, no. 4, pp. 2760–2771, Aug. 2022, doi: 10.1007/s11694-022-01400-7.

[15] T. T. George, A. O. Obilana, A. B. Oyenihi, and F. G. Rautenbach, "Moringa oleifera through the years: a bibliometric analysis of scientific research (2000-2020)," *South African Journal of Botany*, vol. 141, pp. 12–24, Sep. 2021, doi: 10.1016/j.sajb.2021.04.025.

[16] G. H. Baek, Y. J. Kim, Y. Lee, S. C. Jung, H. W. Seo, and J. S. Kim, "Prebiotic potential of green banana flour: impact on gut microbiota modulation and microbial metabolic activity in a murine model," *Front Nutr*, vol. 10, 2023, doi: 10.3389/fnut.2023.1249358.

[17] M. Khoza, E. Kayitesi, and B. C. Dlamini, "Functional properties and in vitro starch digestibility of infrared-treated (micronized) green banana flour," *J Sci Food Agric*, vol. 103, no. 9, pp. 4329–4339, Jul. 2023, doi: 10.1002/jsfa.12511.

[18] P. Kumari, S. S. Gaur, and R. K. Tiwari, "Banana and its by-products: A comprehensive review on its nutritional composition and pharmacological benefits," *eFood*, vol. 4, no. 5, Oct. 2023, doi: 10.1002/efd2.110.

[19] S. R. Dibakoane *et al.*, "Nutraceutical Properties of Unripe Banana Flour Resistant Starch: A Review," *Starch-Stärke*, vol. 75, no. 9–10, Sep. 2023, doi: 10.1002/star.202200041.

[20] C. Vieira Bezerra, A. DA Manoel Cruz Rodrigues, E. Regina Amante, and L. DA Helena Meller Silva, "Nutritional Potential of Green Banana Flour Obtained by Drying in Spouted Bed," *Rev. Bras. Frutic., Jaboticabal-SP*, pp. 1140–1146, 2013.

[21] S. Teeta, M. Sarobol, W. Pharanat, N. Muangtha, and Y. Poratoso, "Effects of using green banana flour as a substitute for wheat flour on the production of chiffon cakes," *Food Agricultural Sciences and technology*, vol. 9, no. 2, pp. 66–78, 2023.

[22] T. N. Giau, N. M. Thuy, V. Q. Tien, and N. Van Tai, "Quality Evaluation of Waffles Produced from The Partial Replacement of Wheat Flour with Green Banana Flour and Potato Strach," *Acta Sci Pol Technol Aliment*, vol. 22, no. 1, pp. 13–21, 2023, doi: 10.17306/J.AFS.2023.1076.

[23] D. Desnilasari, L. Ratnawati, D. Kristanti, R. Ekafitri, and D. N. Surahman, "Used rice and banana flour to formulated nutritious snacks for elderly," *Emir J Food Agric*, vol. 35, no. 6, pp. 562–568, 2023, doi: 10.9755/ejfa.2023.v35.i6.3111.

[24] H. I. U. Thilakarathna, G. N. Jayarathna, and D. C. Mudannayake, "Probiotic ice cream incorporated with blue pea flower (Clitoria ternatea) as a natural colorant and dehydrated banana flour as a potential prebiotic ingredient," *Food and Life*, vol. 2023, no. 2, pp. 67–75, Jun. 2023, doi: 10.5851/fl.2023.e7.

[25] G. da S. Oliveira *et al.*, "Antimicrobial Coating Based on Tahiti Lemon Essential Oil and Green Banana Flour to Preserve the Internal Quality of Quail Eggs," *Animals*, vol. 13, no. 13, Jul. 2023, doi: 10.3390/ani13132123.

[26] D. Castro-Criado *et al.*, "Valorization of Honduran Agro-Food Waste to Produce Bioplastics," *Polymers (Basel)*, vol. 15, no. 12, Jun. 2023, doi: 10.3390/polym15122625.

[27] S. Phimsen, P. Jannoey, T. Boonsong, W. Meemuk, D. Thalapphet, and N. Kijchalao, "Anticancer Activity of Banana Flour Extracts on Colorectal Cancer Cells," *Life Sciences and Environment Journal*, vol. 24, no. 1, pp. 74–86, 2023.

[28] S. Sugiharto *et al.*, "The Use of Unripe Banana Flour as a Functional Feed Ingredient on Blood Profile, Serum Biochemical and Intestinal Indices of Broilers," *Open Agric J*, vol. 17, no. 1, Jan. 2023, doi: 10.2174/18743315-v17-e230110-2022-44.

[29] O. M. Rahmawati *et al.*, "Effect of unripe banana flour as a functional feed ingredient on growth performance, internal organ relative weight and carcass traits of broilers," *Vet Med Sci*, vol. 9, no. 2, pp. 851–859, Mar. 2023, doi: 10.1002/vms3.1070.