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Bibliometric analysis of *Murraya koenigii* (L.) Spreng research: Trends and hotspots

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Abstract:
This paper aims to establish the significance of its studies within the current research landscape and to investigate their methodologies, conclusions, and trends. Utilizing the search term "*Murraya koenigii*," we examined Scopus to identify bibliometric trends and hotspots. To accomplish this aim, 735 original publications published between 2013 and 2025 were retrieved and analyzed using bibliometric analysis, which was based on the Scopus Dataset results. BibTex and CVS (comma-separated values) files containing the data were exported, and Bibliometrix was implemented for the analysis. Studies on *M. koenigii* have been steadily increasing; 889 publications were identified in the Scopus database. Research articles accounted for 82.7% of the publications, followed by reviews (10.6%) and book chapters (3.1%). The findings presented here provide a preliminary visual summary of the scientific output of *M. koenigii*, taking into consideration the authors, study topics, journal citation coupling, and keyword analysis.

Keywords: Bibliometric analysis; Herbal medicine; *Murraya koenigii*; Scientific production; Scopus database; Rstudio; VOSviewer

1. Introduction

Humans employ plants in various ways to meet essential needs, such as clothing, food, and shelter. Both rural and urban cultures depend on wild plants for crafts, medicines, and cosmetics. Furthermore, rural communities rely on wild plants as a source of work and revenue. Medicinal plants are integral to multiple sectors such as food production, medicinal chemistry, pharmaceuticals, and the cosmetics and fragrance industries (Mohammadhosseini et al., 2022). Their rich content of bioactive compounds supports a broad spectrum of therapeutic applications, underscoring their relevance in both traditional and contemporary medical practices (Singh et al., 2023a; Sharif et al., 2024). Recent literature has documented the considerable pharmacological potential of these plants, emphasizing their phytochemical diversity, ethnobotanical significance, and promising role in the development of natural products and novel therapeutics (Eljabboury et al., 2023; Mohammadhosseini et al., 2023). These findings highlight the increasing global importance of plant-derived compounds in advancing public health, biomedical research, and biotechnological innovation.
Native to India, *Murraya koenigii* L. (curry tree) is a tropical to subtropical tree. *M. koenigii* reaches a height of 6 m as a small tree or shrub. In ancient medicine, green curry leaves were frequently utilized to cure piles, inflammation, itching, new cuts, diarrhea, and edema. Although the bark may be used to treat snakebites, the roots have traditionally been utilized to relieve body aches (Mondal et al., 2022; Bhupatiraju et al., 2023; Singh et al., 2023b).
Even after drying, the distinctive scent, mildly spicy flavor, and bitter aftertaste of fresh *M. koenigii* leaves are retained

(Franyoto et al., 2024). Curry leaves, both fresh and dried, are extensively utilized to flavor and season food in South Indian cooking and are regarded as an essential component. Curry leaves have well-established therapeutic potentials such hypoglycemic, hypolipidemic (Kesari et al., 2007; Lawal et al., 2008; Phatak et al., 2021), atherosclerotic (Ambreen et al., 2020), nephroprotective (Yankuzo et al., 2011; Mahipal et al., 2017), gastroprotective (Firdaus et al., 2014), hepatoprotective (Desai et al., 2012), cardioprotective (Kadam et al., 2011), and cholesterol-lowering effects in experimental animals (Chang et al., 2006). The alcoholic leaf extract possessed anticancer (Amna et al., 2019), antioxidant (Gupta et al., 2009; Rajendran et al., 2014), antidiarrheal (Mandal et al., 2010), wound-healing (Nagappan et al., 2012), analgesic, anti-inflammatory (Gupta et al., 2010; Khurana et al., 2019), antipyretic (Pokala et al., 2019), antitrichomonal (Adebajo et al., 2006), antibacterial (Nguyen et al., 2012), antifungal (Tripathi et al., 2018), antileishmanial (Mandal et al., 2017), anti-obesity (Tembhurne et al., 2012), and immunomodulatory properties (Shah et al., 2008; Paul et al., 2011).

M. koenigii leaves contain various chemical constituents with varying pharmacological/biological activities as well as nutritive and aromatic properties. A few chemical components are α-caryophyllene, α- and β-phellandrene, δ-elemene, and β-elemene. These molecules enable plants to keep food fresh for a longer period. Other chemicals include *m*-cymene, α-terpinene, β-myrcene, camphene, α-thujene, *cis*-β-ocimene, *cis*-piperitol, linalool, γ-terpinene, terpinyl acetate, and caryophyllene oxide. In addition, the plant is a rich source of coumarin glycoside, scopotin, calcium, phosphorus, iron, thiamine, riboflavin, niacin (nicotinic acid), sitosterol, carotene, 1,4-methanoazulen-9-ol, caryophyllene oxide, phytol, pinene, phenolic compounds, girinimbiol and girinimbine (carbazole alkaloids) (Gahlawat et al., 2014; Singh, 2014).

Bibliometric analysis is a quantitative method for examining scientific literature and publications. It involves evaluating bibliographic information to learn more about the influence and results of research, particularly citations, authorship, and publication patterns. Bibliometric analysis primarily aims to evaluate the effect and significance of academic literature in a specific subject or field of study. The influence of certain publications, journals, or even particular researchers can be assessed by citation pattern analysis. In addition to new trends and fields of study, this method may be employed to identify influential authors and publications. Furthermore, bibliometric analysis makes it possible to evaluate the productivity of scientists by calculating variables such as publication output, collaboration networks, and citation rates. This information is valuable for researchers, institutions, and funding agencies as it aids in decision-making, resource allocation, and evaluation of research performance.

Overall, bibliometric analysis provides valuable insights into the research landscape, enabling researchers to generate informed decisions and contribute to the advancement of knowledge in their respective fields (Donthu et al., 2021). In this method, bibliographic data, including citation counts, authorship patterns, publishing trends, and co-citation networks are collected and analyzed using bibliographic databases such as Web of Science Core Collection (WOSCC), and Scopus.

Table 1. Main information bibliometric indicators for publications on *Murraya koenigii* (2013-2025).

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2013-2025
Sources (Journals, Books, etc)	455
Documents	735
Annual Growth Rate %	-3,84
Document Average Age	5.88
Average Citations Per Doc	14.47
References	30329
DOCUMENT CONTENTS	
Keywords Plus (ID)	8116
Author's Keywords (DE)	2273
AUTHORS	
Authors	2940
Authors of Single-Authored Docs	20
AUTHORS COLLABORATION	
Single-Authored Docs	23
Co-Authors per Doc	4.81
International co-authorships %	16.19
DOCUMENT TYPES	
Article	735

This paper presents an overview of the knowledge regarding the mechanisms of action and essential bioactive components of *M. koenigii*, which is consistent with our interest in examining the knowledge that the scientific community and the world possess about medicinal plants. This effort is equally vulnerable to the effect of the amount, scope, and worldwide distribution of the knowledge generated. It also provides everyone interested in traditional medicine a platform to learn about the people involved in this field in real time, which can help with future scientific collaboration. To achieve this, we employed bibliometric methods to uncover our objective. This paper aimed to discuss bibliometric analysis in general and its applicability specifically to *M. koenigii* research.

2. Methodology

2.1 Data source

Published papers about *M. koenigii* were collected from Scopus on June 10, 2025. Scopus was chosen because it is a more comprehensive and extensive database than the Web of Science, offering advantages in both keyword searches and citation analysis (Falagas et al., 2008; Bamel et al., 2020).

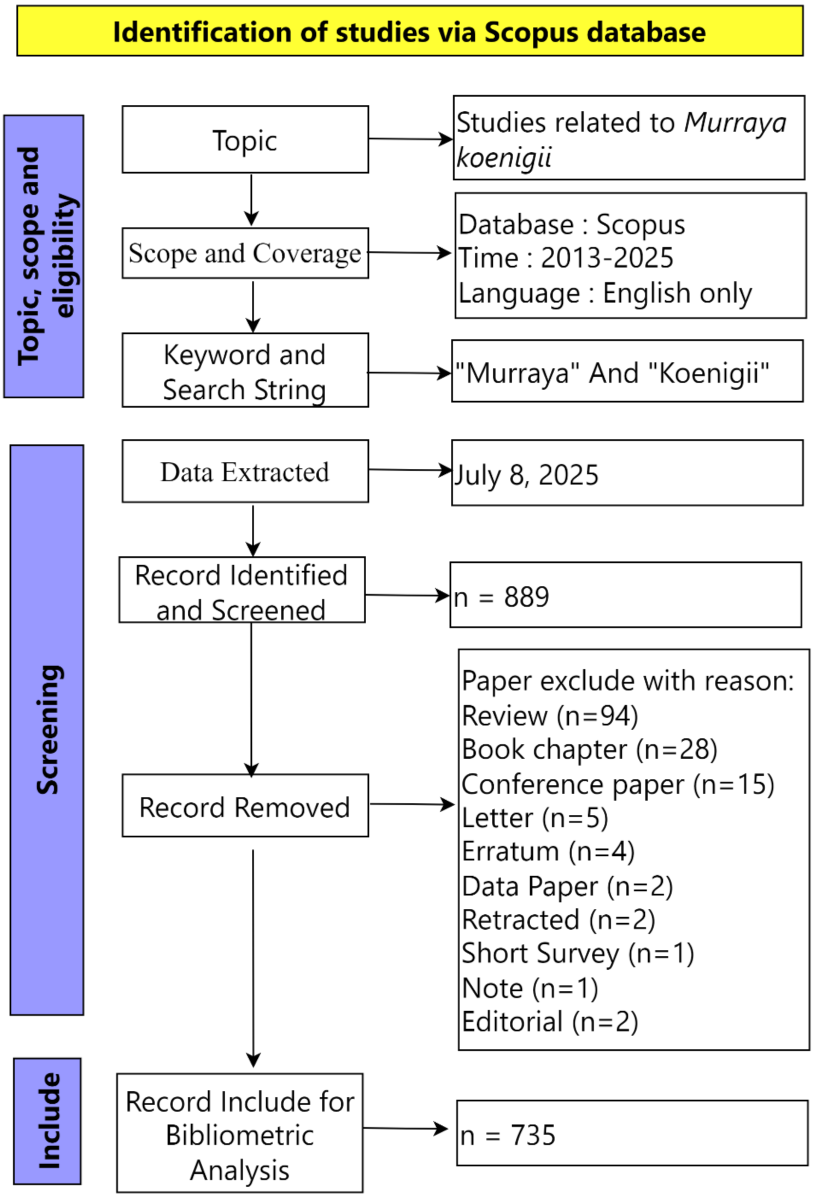


Figure 1. Scopus Database Searching methodology.

Google Scholar was not employed because its poor data quality raises concerns about its usefulness for research evaluation (Mongeon et al., 2016). Data collection was performed by the following search pattern: [TITLE-ABS-KEY ("*Murraya koenigii*")]. These keywords were used in scientific journals' titles, abstracts, or keywords. The entire text that met the criteria for inclusion and exclusion was evaluated. The inclusion criteria were as follows: Literature from Scopus that was published between 2013 and 2025, only in English, and on subjects related to *M. koenigii*. Fig. 1 explains the stages of article extraction, which incorporate filters that select only English original literary items.

2.2 Data extraction and analysis

Fig. 1 depicts the data extraction and analysis process. For bibliometric analysis, eligible documents were saved as ".CSV" and transferred to RStudio®. Bibliometric analysis was conducted using the Bibliometrix platform and the BiblioShiny application from RStudio® and VOSviewer (Aria et al., 2017). In addition to supporting knowledge mapping, this comprehensive tool facilitates data analysis, including essential deconstruction and visualization. The analysis of data produced by VOSviewer and BiblioShiny, a filter-based tool incorporated in the Bibliometrix package, is the objective of this study (Agbo et al., 2021).

3. Results and discussion

3.1 Main information about the collection

Table 1 presents the primary conclusions from the examination of the document type, document content, and author collaboration. The research encompasses the period from 2013 to 2025 and has 735 total documents, with an average of 14.47 citations per document. According to the analysis, 455 scientific sources had articles. Of all the works that comprise the study sample, authors used only 2273 of the

8116 keywords. Single authors are relatively uncommon in publications of this type. There was just one author behind 20 of the 735 recoverable works. In total, 2940 academics contributed to this tree.

3.2 Country and affiliation production

The distribution of scientific production frequencies across the globe by affiliation country is depicted in Fig. 2. Journal articles on works associated with *M. koenigii* have been published in collaboration with authors from 50 countries. In the top 5, India, with 2,040 frequencies, ranks first, while Malaysia, with 313 frequencies, holds the second position, both challenging the hegemony of academic-scientific production. Pakistan (125 frequencies) ranks third, China (117 frequencies) ranks fourth, and Indonesia (111 frequencies) ranks fifth. The universities with the most published works on *M. koenigii* were the Universiti Putra Malaysia (Malaysia), Universiti of Malaya (Malaysia), Jazan University (Saudi Arabia), King Saud University (Saudi Arabia), and CSIR-Indian Institute of Integrative Medicine (India).

3.3 Publication trends

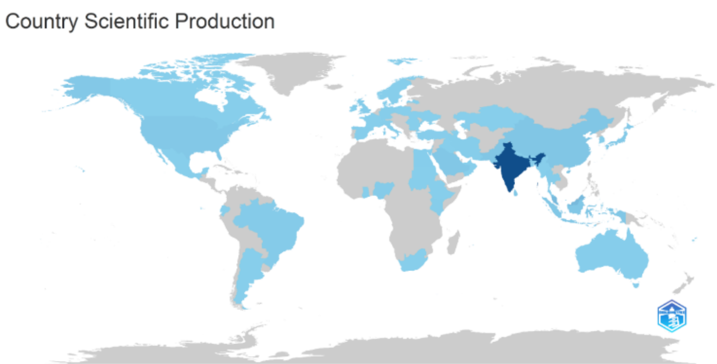
The publication output of 735 documents on *M. koenigii* from 2013 to June 2025 is displayed in Fig. 3A, demonstrating an overall increase in trend. In 2020, the largest number of publications was 74. According to the growth trend model, a close relationship exists between the annual increase and the number of connected articles. The growing interest of researchers and the general public in this important subject is evidenced by the increasing number of scientific publications related to plant studies. Plant efficacy's increasing importance for the health of the ecosystem and well-being of humans could be an explanation for the increase in publications on this topic.

Research progress on any topic of study can be monitored closely by examining the publication output. It is quantified by the number of articles that are published in books, journals, conference proceedings, etc. After research articles (82.7%), reviews (10.6%) and book chapters (3.1%) constituted the next two most common types of publications. The remaining publications included editorial materials, conference papers, letters, data documents, and notes. This indicates that academics, both locally and abroad, have been more interested in studying *M. koenigii*.

3.4 Analysis of contribution and cooperative relationship

In research on *M. koenigii*, 2,940 authors from 719 institutions in 40 countries took part between 2013 and 2025. Fig. 3B illustrates the countries of the corresponding authors. India (number of publications [NP] = 403 article, 54.8% of the total) was among the top 10 countries that contributed to the research on *M. koenigii*. Other countries that prompted this list were Malaysia (NP = 50, 6.8%), Sri Lanka (NP = 23, 3.1%), Indonesia (NP = 16, 2.2%), Pakistan (NP = 15, 2.0%), USA (NP = 15, 2.0%), China (NP = 13, 1.8%), Saudi Arabia (NP = 13, 1.8%), Brazil (NP = 8, 1.1%), and Bangladesh (NP = 7, 1.0%). Sri Lanka and Malaysia were among the most significant publishing countries after India.

The most pertinent source for publications on *M. koenigii* is presented in Fig. 3C. Since journals are considered essential instruments for disseminating research, the level of quality and reputation of a journal are crucial in distributing information to the appropriate segment of the population. The Journal of Ethnopharmacology (NP = 12), Research



No	Country	Freq	No	Country	Freq
1	INDIA	2040	26	TURKEY	9
2	MALAYSIA	313	27	SOUTH AFRICA	8
3	PAKISTAN	125	28	SWITZERLAND	8
4	CHINA	117	29	LATVIA	7
5	INDONESIA	111	30	MEXICO	7
6	SAUDI ARABIA	108	31	FRANCE	6
7	SRI LANKA	96	32	POLAND	6
8	USA	85	33	BHUTAN	5
9	JAPAN	57	34	CANADA	5
10	NIGERIA	50	35	FIJI	4
11	BRAZIL	44	36	IRAQ	4
12	THAILAND	31	37	ETHIOPIA	3
13	UK	31	38	MYANMAR	3
14	BANGLADESH	24	39	AZERBAIJAN	2
15	NEPAL	24	40	BULGARIA	2
16	KENYA	23	41	IRELAND	2
17	SOUTH KOREA	20	42	ROMANIA	2
18	GERMANY	19	43	SUDAN	2
19	MAURITIUS	17	44	SWEDEN	2
20	ITALY	14	45	ARGENTINA	1
21	IRAN	12	46	DENMARK	1
22	AUSTRALIA	11	47	ECUADOR	1
23	EGYPT	11	48	GHANA	1
24	SPAIN	11	49	ISRAEL	1
24	SINGAPORE	10	50	KAZAKHSTAN	1

Figure 2. Country production. The map illustrates the scientific productivity attributed to the plant under investigation. The figure was generated using the Bibliometrix program. A positive correlation was found between the intensity of the blue hue and the level of scientific productivity.

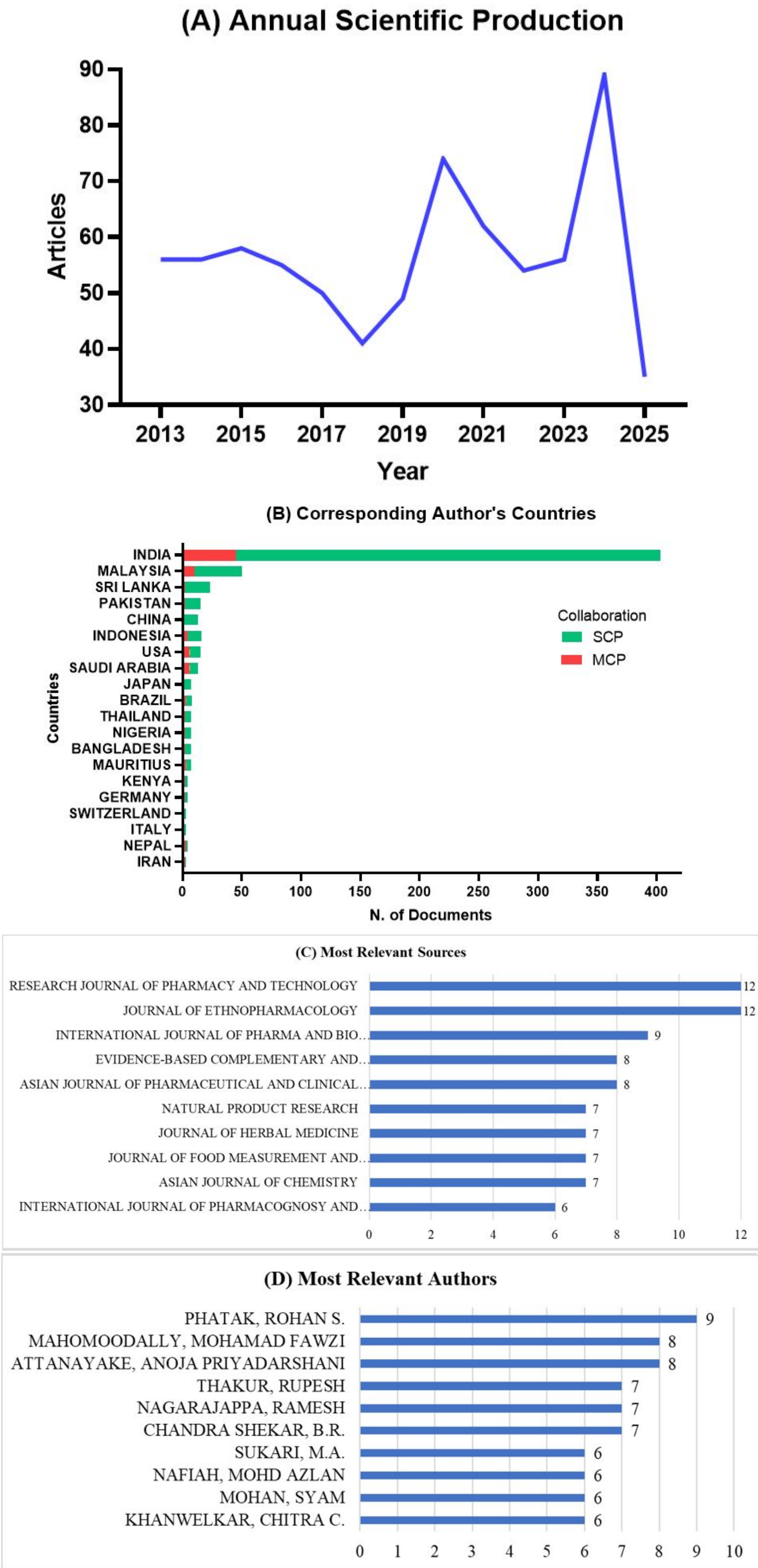


Figure 3. (A) Growth trend model. The vertical coordinates on the left indicate the number of related articles published in the year, whereas the abscissa indicates the year. (B) Corresponding author's countries. (C) Most relevant source. (D) Most relevant authors.

Journal of Pharmacy and Technology (NP = 12), and International Journal of Pharma and Bio Sciences (NP = 9), are the top three journals in terms of publication volume among the 381 institutions that investigated *M. koenigii*. The authorship pattern of research by *M. koenigii* demonstrates the tendency toward collaborative research, which is evident across both scientific and medical areas. Fig. 3D highlights the 10 most prolific authors. The order of most posts was Phatak, Rohan S. Attanayake, and Anoja Priyadarshani.

3.5 Keyword analysis

A keyword analysis is an effective way of tracking research hotspots and predicting developmental trends (Chen, 2004). The article's 8,116 keywords offer an invaluable resource for readers to comprehend the methodology, research subject, and objectives by reflecting on its primary key concepts. Keyword analysis may offer a deeper understanding of the relevant academic topic and its framework by categorizing and aggregating high-frequency words. For instance, a keyword's high frequency may indicate that the academic area in which it originates is presently a hotspot for research. The top 20 keywords and their frequency are provided in Table 2.

3.6 Co-citation analysis

Co-citation analysis is an effective method of identifying patterns and trends in the dynamics and organization of scientific literature. When article A cites an already-published article B, article A is the citing article, and article B is the referenced reference. This is recognized as a citation. When a third article simultaneously references two references, it is referred to as a co-citation. A discipline is constructed on a collection of co-cited references, and its frontiers of inquiry are represented by the cited articles.
Out of the 607 total papers, 482 had at least one citation. These papers received an average of 15.61 citations per manuscript, totaling 7.528 citations. A summary of the citation count indicates that 49 publications have one citation, 50 have two, 100 have 3-5, 87 have 6-10, and 88 have 11-20 citations. Eighty papers have a citation count of 20-50, 21 have 51-100, and 5 have 101-200. Two articles that have received ≥ 200 citations are presented in Fig. 4.

3.7 Current trends in *Murraya koenigii* studies

Current trends in *Murraya koenigii* studies have evolved over the last 10 years (Fig. 5). The analysis of trendy topics was conducted in Bibliometrix applications using keywords. Keywords such as "catalase," "IC_{50}", "liver toxicity", "plant leaf", "*Murraya koenigii* extract", "plant extracts", "drug

Table 2. Top 20 keywords and their frequency.

Keyword	Frequency	Keyword	Frequency
Murraya koenigii	477	Chemistry	114
Article	373	Plant extracts	96
Nonhuman	278	Antioxidant activity	94
Controlled study	241	Animal experiment	93
Plant leaf	198	Male	91
Murraya koenigii extract	196	Antioxidant	85
Unclassified drug	186	Phytochemistry	83
Plant extract	168	Animals	82
Human	135	Alkaloid	80
Murraya	129	*In vitro* study	79

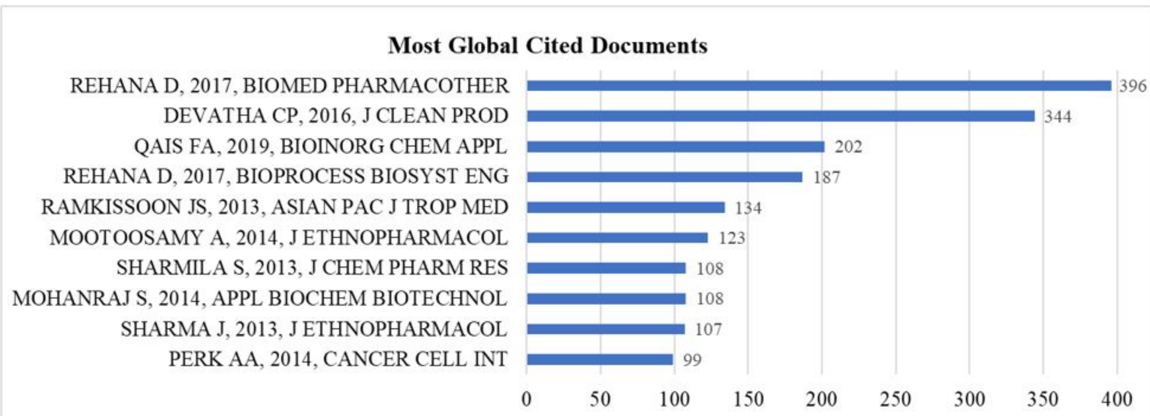


Figure 4. Most cited document globally.

screening", and "cell line" are strongly related to the current trends in *M. koenigii* research. In Fig. 5, the time span of the keyword is shown in the vertical line.

3.8 Keyword co-occurrence analysis

Keywords identified through co-occurrence analysis represent a high-level summary and conceptual refinement of scientific publications (Xie et al., 2020). A co-occurrence analysis of keywords is an efficient method to demonstrate the structure of scientific knowledge and identify hotspots and research frontiers in a specific domain. Terms that are derived from keywords can be mapped and clustered to quickly identify study subjects. The analysis highlights emerging research trends in *M. koenigii* research (Fig. 6 and Table 3).

Clustering is both a bibliometric analysis method and an enrichment technique. Integrating network clusters into subject clusters, monitoring the evolution of these topic clusters, and understanding the emergence and evolution of a study field are the primary objectives. Six clusters were identified, which included antibacterial action, phytochemical, animal experimentation, medication effect, essential oils, and free radical scavenging.

This study contributes to the existing body of research by illustrating the theoretical and methodological foundations within a timeline applicable to various contexts. It identifies publishing patterns, nations, organizations, publishers, and key papers that have made significant contributions. Two approaches, such as management and scientific aspects, are discussed in this study. The highest number of articles was recorded during the period between 2020 and 2021, although the annual publication output showed fluctuations. If additional management elements of bibliometric analysis that evaluate the productive countries, institutions, publishers, and authors are considered, it will be more straightforward for other researchers to initiate a research network and collaborate.

The traditional Indian medical system records *M. koenigii* as a significant plant with numerous pharmacological qualities and advantageous therapeutic effects. Most articles about this plant have originated from Asia, particularly from Malaysia and India. This may be because *M. koenigii* has been extensively discovered and utilized in these countries for cooking and medicinal purposes, allowing them to benefit from the results of their collective research.

Visual analysis results indicate that *M. koenigii* has a global effect, and in the past 20 years, research in associated domains has increased. Scientific research institutes are the primary source of research institutions in *M. koenigii*-related fields, which are followed by all levels of colleges and uni-

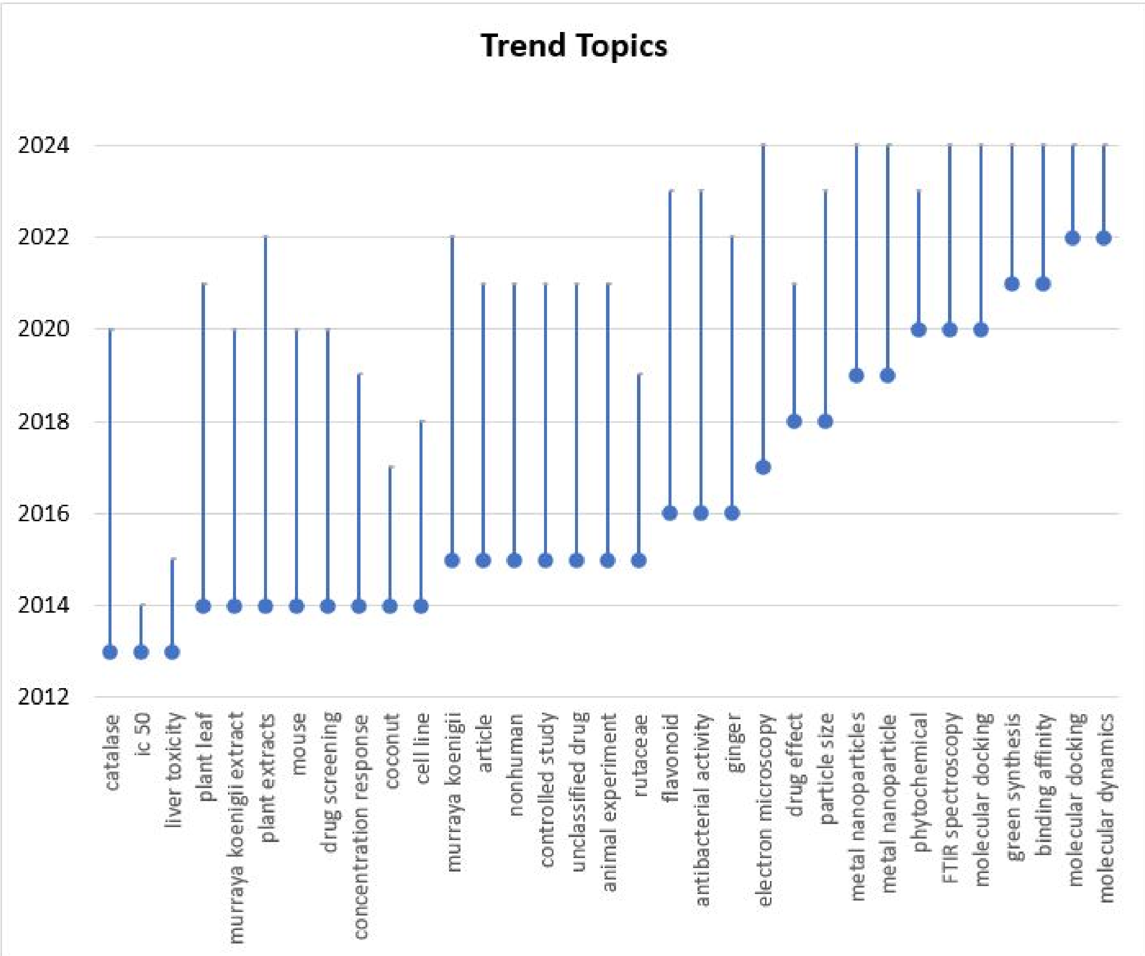


Figure 5. Trending topics in *Murraya koenigii* studies. The figure was generated using biblioshiny application in Bibliometrix and BibTex data format (n = 735).

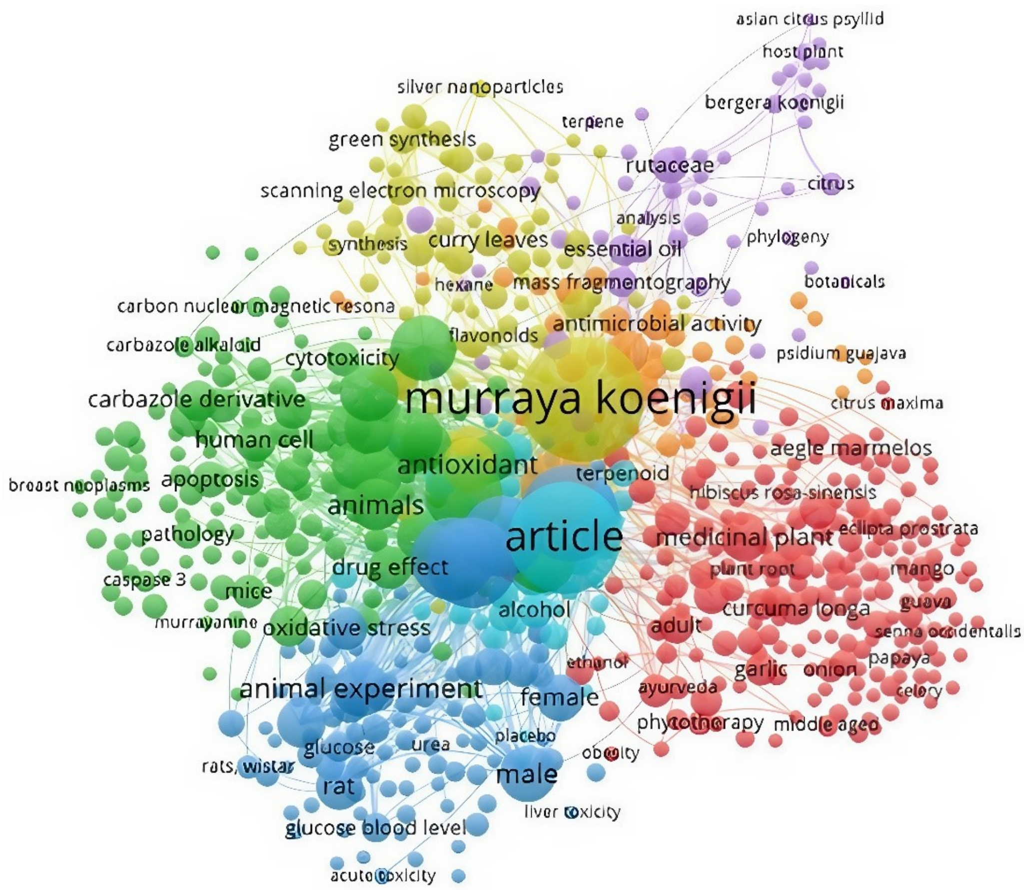


Figure 6. Keyword co-occurrence network. Minimum number of occurrences of a keyword = 10, minimum links strength = 10. Overall, 661 keywords met the threshold criteria. There are seven clusters of keywords: red indicates cluster 1 (n = 191); green, cluster 2 (n = 139); blue, cluster 3 (n = 93); yellow, cluster 4 (n = 82); purple, cluster 5 (n = 57); light blue, cluster 6 (n = 53); orange, cluster 7 (n = 46).

Table 3. Highlighting the keyword co-occurrence network analysis based on all keywords.

Cluster	**Keywords**	**Thematic interpretation**
Cluster 1 (red nodes/191)	*Acalypha indica*, *Achyranthes aspera*, *Acorus calamus*, adult, *Aegle marmelos*, *Aegle marmelos* extract, aged, *Ageratum conyzoides*, *Aloe vera*, *Andrographis paniculata*, *Annona muricata*, *Annona squamosa*, antiviral activity, *Asparagus racemosus*, *Asparagus racemosus* extract, asteraceae, aubergine, avocado, Ayurveda, *Azadirachta indica*, *Azadirachta indica* extract, *Bacopa monnieri*, bark, basil, *Bauhinia variegata*, biodiversity, black cumin, black pepper, black pepper extract, Boerhavia diffusa, brain, *Brassica oleracea*, *Camellia sinensis*, *Capsicum annuum*, cardamom, cardiovascular disease, carotenoid, carrot, *Cassia fistula*, *Catharanthus roseus*, celery, *Centella asiatica*, *Centella asiatica* extract, *Cinnamomum zeylanicum*, cinnamon, *Citrus maxima*, Clerodendrum, clove, *Coccinia grandis*, coconut, *Colocasia esculenta*, coriander, *Coriandrum sativum* extract, cucumber, cumin, *Curculigo orchioides*, *Curcuma longa*, *Curcuma longa* extract, *Cymbopogon citratus*, *Cyperus rotundus*, dandruff, diabetes mellitus, diarrhea, drug safety, *Eclipta prostrata*, *Emblica officinalis*, *Emblica officinalis* extract, enzyme inhibition, enzymology, *Eryngium foetidum*, ethanol, ethnobotany, ethnopharmacology, *Eucalyptus globulus*, *Euphorbia hirta*, Euphorbiaceae, Fabaceae, fennel, fenugreek, fenugreek extract, fever, *Ficus*, *Ficus benghalensis*, *Ficus racemosa*, *Ficus religiosa*, flower, food, fruit garlic, garlic extract, ginger, ginger extract, *Glycyrrhiza glabra*, guava, *Gymnema sylvestre*, herb, herbaceous agent, herbal medicine, *Hibiscus rosasinensis*, hypertension, *Justicia adhatoda*, *Lagenaria siceraria*, *Lantana camara*, *Laurus nobilis*, *Lawsonia inermis*, lemon, lime (fruit), linseed, major clinical study, malaria, mandarin, mango, Mauritius, medicinal plant, medicinal plants, medicine, traditional, *Mentha arvensis*, *Mentha piperita*, middle aged, *Mimosa pudica*, *Momordica charantia*,	Medicinal plants

Continued of Table 3.

Cluster	Keywords	Thematic interpretation
	Morinda citrifolia, *Moringa oleifera*, *Moringa oleifera* extract, mustard, non-insulin dependent, nutmeg, oat, obesity, *Ocimum sanctum* extract, *Ocimum tenuiflorum*, olive tree, onion, Oroxylum, pain, papaya, paracetamol, parsley, *Phyllanthus emblica*, *Phyllanthus niruri*, phytotherapy, pineapple, *Piper betle*, plant medicinal product, plant preparations, plant root, plant seed, plant stem, plants, medicinal, pomegranate, *Pongamia pinnata*, pruritus, quality control, quantitative analysis, questionnaire, rhizome, *Ricinus communis*, rosemary, rubus, *Senna alata*, *Senna occidentalis*, *Senna tora*, sesame, skin disease, *Solanum nigrum*, species diversity, spice, spinach, stomach pain, sweet orange, sweet potato, *Syzygium cumini*, tamarind, *Terminalia arjuna*, *Terminalia bellirica*, *Terminalia chebula*, *Terminalia chebula* extract, thyme, *Tinospora cordifolia*, tomato, traditional healer, traditional medicine, turmeric, unindexed drug, velvet bean, viscosity, *Vitex negundo*, watercress, *Withania somnifera*, *Withania somnifera* extract, young adult.	
Cluster 2 (green nodes/139)	Aldehyde reductase, alkaloid, alkaloid derivative, alkaloids, animal, animal cell, animals, anti-inflammatory agent, antiinflammatory agent, antimalarial activity, antineoplastic activity, antineoplastic agent, antineoplastic agents, antiproliferative activity, apoptosis, binding affinity, biological activity, breast cancer, breast cancer cell line, breast neoplasms, cancer inhibition, carbazole, carbazole alkaloid, carbazole alkaloids, carbazole derivative, carbazoles, carbon nuclear magnet, caspase 3, caspase 9, catechin, cell cycle arrest, cell death, cell line, cell line-tumor, cell proliferation, cell survival, cell viability, chemical structure, chemistry, colon cancer, computer model, cytochrome c, cytokine, cytotoxicity, diet, disease model, disease models-animal, DNA damage, dose response, dose-response relation, down regulation, drug bioavailability, drug cytotoxicity, drug effect, drug effects, drug isolation, drug mechanism, drug potency, drug resistance, drug screening, drug screening assays, drug structure, drug synthesis, enzyme activation, flow cytometry, gene expression, gene expression regulation, girinimbine, glucose transporter 4, hela cell line, hela cells, heteronuclear multiple, high performance liquid, human, human cell, humans, IC_{50}, IC_{50}, immunoglobulin enhancer, *in vitro* study, *in vivo* study, inflammation, insulin resistance, interleukin 1 beta, interleukin 6, isolation and purification, koenidine, koenimbine, limit of detection, limit of quantitation, lipopolysaccharide, liquid chromatography, lung cancer, macrophage, mahanimbicine, mahanimbine, mahanine, metabolism, mice, mitochondrial membrane, molecular docking, molecular structure, mouse, MTT assay, murraya, murrayanine, myricetin, natural product, neuroprotective agent, nitric oxide, nuclear magnetic resonance, pathology, plant extracts, plant leaves, polycyclic aromatic hydrogen, priority journal, protein bax, protein bcl 2, protein expression, protein kinase b, proto-oncogene protein, proton nuclear magnetic, quercetin, raw 264.7 cell line, reactive oxygen metabolism, reactive oxygen species, real time polymerase chain, rutoside, signal transduction, structure activity relation, structure-activity relation, tandem mass spectrometry, tumor cell line, tumor necrosis factor, unclassified drug, upregulation, Western blotting.	Drug effect
Cluster 3 (blue nodes/93)	Acute toxicity, aging, alanine aminotransferase, albumin, alkaline phosphatase, Alzheimer disease, animal experiment, animal model, animal tissue, antidiabetic activity, antidiabetic agent, aqueous solution, aspartate aminotransferase, bilirubin, biochemical analysis, biological marker, blood, blood glucose, blood sampling, body weight, catalase, cholesterol, cholesterol blood level, controlled study, creatinine, creatinine blood level, cytochrome c oxidase, diabetes, diabetes mellitus, drug dose comparison, drug efficacy, drug megadose, enzyme activity, erythrocyte count, experimental diabetes, female, glibenclamide, glucose, glucose blood level, glucose transport, glutathione, glutathione peroxidase, glutathione reductase, glutathione transferase, high density lipoprotein, histology, histopathology, hyperglycemia, hyperlipidemia, hypoglycemic agents, hypolipidemic activity, insulin, lactate dehydrogenase, ID50, lead acetate, lipid diet, lipid peroxidation, liver injury, liver protection, liver toxicity,	Animal experiment

Continued of Table 3.

Cluster	**Keywords**	**Thematic interpretation**
	locomotion, low drug dose, male, malonaldehyde, metformin, *Murraya koenigii* extract, myeloperoxidase, neuroprotection, nitrogen, nonhuman, oxidative stress, plant leaf, plant protein, rat, rats, Wistar, renal protection, single drug dose, spectrophotometry, Sprague-Dawley rat, Sri Lanka, streptozocin, streptozotocin-induced, superoxide dismutase, toxicity testing, triacylglycerol, triacylglycerol blood level, urea, urea nitrogen blood level, water, Wistar rat, xanthine oxidase.	
Cluster 4 (yellow nodes/82)	*Acalypha indica* extract, acetylcholinesterase, alpha glucosidase, amino acids, anti-bacterial activity, anti-diabetic, anti-inflammatory, anti-microbial activity, antibacterial, antidiabetic, antimicrobial, antioxidant, antioxidants, bacteria, bacteriology, biochemistry, biosynthesis, cadmium, calcium, cell culture, chlorophyll, concentration, *Coppercoriandrum sativum*, cost effectiveness, curry leaf, curry leaves, diseases, drug stability, drying, *Escherichia coli*, extraction, fermentation, flavonoids, Fourier transform infrared, free radicals, fruits, FTIR, green chemistry, green synthesis, high resolution transmission, HPLC, infrared spectroscopy, iron, lead, leaf extracts, liquid chromatography, magnesium, medical applications, metabolites, metal nanoparticle, metal nanoparticles, moisture, *Murraya koenigii*, nanoparticle, nanoparticles, particle size, particle size analysis, pH, phenols, physical chemistry, physicochemical property, phytochemical, phytochemicals, plants (botany), procedures, scanning electron microscopy, silver, silver nanoparticle, silver nanoparticles, spectroscopy, synthesis, synthesis (chemical), temperature, total phenolic content, toxicity, transmission electron, Ultra performance liquid, Ultraviolet spectroscopy, X-ray diffraction, zeta potential, zinc oxide.	Phytochemical
Cluster 5 (purple nodes/57)	Acetic acid ethyl ester, acetone, analysis, Asian citrus psyillid, bacterial disease, bacterium, *Bergera koenigii*, bioactive compounds, bioassay, botanicals, caryophyilene, chemical composition, chromatography, Citrus, classification, cluster analysis, *Diaphorina citri*, dicotyledon, disease vector, essential oil, essential oils, forestry, gas chromatography, gas chromatography-mass, GC-MS, genetics, growth, hemiptera, hexane, hexapoda, host plant, huanglongbing, hydrodistillation, India, insect, insecticide, insecticides, larva, leaf, limonene, mass fragmentography, mass spectrometry, microbiology, monoterpenes, mortality, *Murraya exotica*, *Murraya paniculata*, phylogeny, pinene, powder, psyllidae, Rutaceae, sesquiterpene, sesquiterpenes, spices, terpene, terpinene.	Essential oils
Cluster 6 (light-blue nodes/53)	1,1-Diphenyl-2-picrylhydazil, acetic acid, alcohol, amino acid, amylase, analgesic activity, anthelmintic activity, anthraquinone, anticancer, antiinflammatory activity, antioxidant activity, antioxidant assay, article, ascorbic acid, benzene, carbohydrate, cardiac glycoside, chloroform, clinical evaluation, comparative study, concentration response, coumarin, diclofenac, DPPH radical scavenging, drug activity, drug determination, drug formulation, ferric reducing antioxidant, flavonoid, free radical, gallic acid, glycoside, methanol, petroleum ether, phenol, phenol derivative, phytochemistry, phytosterol, placebo, plant glycoside, polyphenol, protein, protein denaturation, qualitative analysis, saponin, saponin derivative, solvent extraction, Soxhlet extraction, steroid, tannin, tannin derivative, terpenoid, triterpenoid.	Free radical scavenging activity
Cluster 7 (orange nodes/46)	Acacia, *Acacia nilotica*, agar diffusion, anti-bacterial agents, antibacterial activity, antibiotic agent, antibiotic resistance, antibiotic sensitivity, antifungal activity, antifungal agent, antiinfective agent, antimicrobial activity, *Bacillus subtilis*, bacterial growth, bacterial strain, bacterium isolate, bacterium isolation, biofilm, biofilms, broth dilution, candida albicans, ciprofloxacin, disk diffusion, drug potentiation, eucalyptus, fluorescence microscopy, Gram-negative bacterium, Gram positive bacterium, growth inhibition, guava extract, *Klebsiella pneumoniae*, microbial sensitivity test, microbial sensitivity tests, minimum bactericidal concentration, minimum inhibitory concentration, oils-volatile, plant extract, plant oils, *Pseudomonas aeruginosa*, *Psidium*, *Psidium guajava*, *Staphylococcus aureus*, *Streptococcus mutans*, streptomycin, vegetable oil, zone of inhibition.	Antimicrobial activity

versities. Research units are not reported in the majority of the studies. Hospitals and research institutes at all levels collaborate the most, followed by colleges and universities. This suggests that the majority of studies on *M. koenigii* is conducted at scientific research institutes, where its pharmacological effects are investigated for clinical trials, highlighting its importance in clinical diagnosis and application. Institutes can provide better scientific research data and a foundation to strengthen cooperation and links between scientific institutes and hospitals at all levels. On the contrary, hospital clinical trials and research can accurately reflect pertinent data and support the scientific institute's analysis. Increasing the number of human and material resources available to hospitals, schools, and institutions may improve collaboration and relationships, complementing each other's theoretical research and study design and enhancing the rigor of analysis. Furthermore, reducing public opinion and associated medication hype through increased collaboration among hospitals, colleges, and institutions can improve the scientific quality of the research.

4. Concluding and remarks

M. koenigii research has received extensive attention globally, and its chemical constituents play crucial roles in traditional medicine research. The present study demonstrated the intellectual and conceptual architecture of the knowledge connected to this plant established during the last 10 years, and it thoroughly examined the scientific evolution of *M. koenigii* research. The novelty of this work lies in its comprehensive bibliometric analysis of *M. koenigii* research over the past decade, which systematically identifies major research themes, emerging trends, and influential contributors. Although this study's methodology establishes the medicinal and dietary value of this tree, it also establishes an important framework for further research in the search for novel pharmacological values. This is particularly relevant by emphasizing the main research topics and promoting further research in the investigated area. The present study has several significant implications, one of which is that this tree is a prospective comparative source for many botanical studies, despite the depth and breadth of research on it. Visual analysis of bibliometrics provides a clear understanding of the status of *M. koenigii* research in various countries and the cooperation between institutions and governments, providing valuable references for future scholars conducting related research in this field. Furthermore, interdisciplinary and transnational collaborations should be encouraged to bridge the gaps between ethnobotanical knowledge, modern pharmacology, and drug development. The insights gained from this study provide a strategic roadmap for researchers, funding bodies, and policymakers to further explore the untapped potential of *M. koenigii* in the biomedical and nutraceutical fields.

Authors contributions
Yuvianti Dwi Franyoto: Conceptualization, methodology, and writing original draft preparation. Nanang Fakhrudin: Writing review and editing. Arief Nurrochmad: Supervision.

Availability of data and materials
The data that support the findings of this study are available from the corresponding author, upon reasonable request.

Conflict of interests
The author declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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