Journal of Pakistan Association of Dermatologists. 2026;**36(2)**:311-321.

Review Article

Global bibliometric analysis of nanoemulsion-based serums for hair growth (2015-2025): Trends, collaborations, and future directions

Mutmainah[1,7], Triana Hertiani[2], Adhyatmika[3], Arief Nurrochmad[4], Eka Noviana[5], Akhmad Kharis Nugroho[6*]

[1]Doctoral Program in Pharmacy, Faculty of Pharmacy, Universitas Gadjah Mada, Indonesia.
[2]Department of Pharmaceutical Biology, Faculty of Pharmacy, Universitas Gadjah Mada, Indonesia.
[3]Department of Pharmaceutics, Faculty of Pharmacy, Universitas Gadjah Mada, Indonesia.
[4]Department of Pharmacology and Clinical Pharmacy, Faculty of Pharmacy, Universitas Gadjah Mada, Indonesia.
[5]Department of Pharmaceutical Chemistry, Faculty of Pharmacy, Universitas Gadjah Mada, Indonesia.
[6]Department of Pharmaceutics, Faculty of Pharmacy, Universitas Gadjah Mada, Indonesia.
[7]Faculty of Pharmacy, Semarang College of Pharmaceutical Sciences, Indonesia.

Abstract

Alopecia and other disorders of hair growth have a significant impact on quality of life. Traditional serum preparations are often limited by several limitations, especially low scalp uptake and poor bioavailability of active ingredients. One proposed approach to overcoming these limitations is the use of nanoemulsions as a delivery system. However, the trends of investigations in this area have not been extensively mapped. Therefore, this study aimed to examine the trends in articles, collaboration, and contribution to the development of nanoemulsion-based hair growth serums from 2015 to 2025. The keywords, including serum AND nanoemulsion OR hair growth, were searched in the Scopus database on September 1, 2025. Following the inclusion criteria, 585 articles were analyzed using RStudio (Biblioshiny) and VOSviewer to assess the trend in articles, collaboration on an international level, and the performance of the journal, as well as the productivity of the authors, and the co-occurrence of the keywords. The results showed that the number of articles has steadily increased over time, with the highest number in 2023 (87 articles). The highest number was recorded in China (n=105), while the United States had the best citation effect and collaboration network. The most productive institution was the National Research Centre, and the most prolific authors were Mona Anwar El-Banna and Mehrez E. El-Naggar. The most common sources of articles were found to be Journal of Cosmetic Dermatology and Pharmaceutics, and the most cited source with the greatest impact was Colloids and Surfaces B: Biointerfaces. Nanoemulsion-based hair growth serums have demonstrated considerable evolution, with a growing global cooperation and scientific presence. These results suggest opportunities to enhance cross-country collaboration, harmonize formulation studies, and expedite the clinical conversion of nanoemulsions-based hair growth therapy products.

Keywords Bibliometric analysis; Scopus; VOSviewer; Nanoemulsion serum; Hair growth.

Article Received on 22.12.2025

Revised on 25.04.2026

Accepted on 14.06.2026

Published on 30.06.2026

Citation: Mutmainah, Hertiani T, Adhyatmika, Nurrochmad A, Noviana E, Nugroho AK. Global bibliometric analysis of nanoemulsion-based serums for hair growth (2015-2025): Trends, collaborations, and future directions. *J Pak Assoc Dermatol*. 2026;**36(2)**:311-321. **Doi: https://doi.org/10.66344/jpad.v36i2.3304**

Introduction

Hair disorders may arise from various contributing factors, including genetic, stress, hormonal, and environmental factors.[1] Among these conditions, Alopecia is a common disorder affecting both men and women.[2] Androgenetic alopecia is the most common form in adults and may impair quality of life due to hair loss and the associated impact on physical appearance.[3] One of the therapeutic methods to address this problem is the use of nanoemulsions, which have been demonstrated to be useful in increasing the solubility of active compounds, stimulating hair growth.[4]

The growing need for safe and clinically proven hair

care products has driven the development of nanoemulsion-based serums for hair growth. Poor penetration and bioavailability of active ingredients in the scalp remains one of the primary limitations of traditional hair growth serums.[5] One proposed approach to overcome these limitations is the use of nanoemulsions as a delivery system. Nanoemulsion formulations, due to the small particle size, facilitate a deeper and more uniform distribution of active compounds, thereby increasing bioavailability. This system offers a more effective, safe, and efficient method of drug delivery, enhancing the stability and bioavailability of active compounds in topical formulations, which are important aspects of hair care. Previous studies have shown that nanoemulsions can increase skin permeability, enabling active ingredients to reach specific targets faster and more efficiently.[6] This reflects how nanoemulsions achieve more effective therapeutic outcomes in hair care compared to conventional methods.[7] However, the trends of investigations in this area have not been extensively mapped.

Bibliometric studies can offer comprehensive insights, reveal gaps in knowledge, elucidate patterns of a researcher involvement, and support the development of new concepts.[8] Several factors can be investigated, including research outputs, institutions, authors, published journals, and knowledge dissemination of a given topic.[9] This research was conducted to address the increasing global demand for more effective and safer hair care products, together with existing gaps in the literature on nanoemulsions in dermatological applications. Nanoemulsion-based serum strategy has a high potential to advance beyond currently used conventional formulations.

Although a few investigations have been conducted to determine nanoemulsion formulations of cosmetic and pharmaceutical products, limited research has focused specifically on application in serum-based hair growth systems. Therefore, more research is required to examine the penetration of drugs in nanoemulsion-based hair growth serums. Finally, the development of effective nanoemulsion based serums offers a safer and more efficient strategy for management of alopecia and other hair growth disorders.[10]

This study seeks to comprehensively assess research dynamics, collaboration patterns, and academic contribution in development of nanoemulsion based hair growth formulations between 2015 and 2025. Despite extensive evidence on nanoemulsion applications in medical and cosmetic fields, a comprehensive bibliometric analysis specifically focused on nanoemulsion-based hair growth serums has not been conducted.[11] This gap offers a basis for this research, which provides a thorough review of the literature on nanoemulsion-based hair care serums in the last ten years. Some of the mapping aspects in the analysis included global collaboration, performance analysis of top universities, evaluation of high impact journals, features of highly cited articles, and new research themes. Only articles included in Scopus and written in English, published since 2015, were selected. This methodology is expected to help future research in designing formulations that fulfill clinical requirements, have minimal toxicity, and improve drug absorption for hair growth. Finally, nanoemulsion-based serums might provide a more effective and safe alternative to those having androgenetic alopecia, as well as other conditions associated with hair thinning and decreased hair density.[10]

Methods

There were no human subjects involved in this research; hence, ethics committee approval and informed consent were not required. The search was performed using an observational design based on a literature database. The Scopus database (https://www.scopus.com), accessed on September 1, 2025, was selected, as it is more comprehensive

Address for correspondence
Prof. Dr. Akhmad Kharis Nugroho, S.Si., M.Si., Apt.
Professor, Department of Pharmaceutics, Faculty of Pharmacy, Universitas Gadjah Mada, Indonesia.
Ph: 082136106565
Emai: a.k.nugroho@ugm.ac.id

than other databases.[11] All research articles relevant to serum, nanoemulsion, and hair growth were retrieved to ensure that the dataset accurately reflects current developments in this field. The search strategy used the keywords "serum" AND "nanoemulsion" OR "hair growth". The inclusion criteria included articles (a) published between 2015 and 2025, (b) written in English, and (c) research. Data collected were exported in CSV format using Microsoft Excel, and then refined through Microsoft Excel to eliminate duplicates and for validation. The characteristics of links and total link strength were measured using the distance between each value. Data were analyzed using Rstudio and VOSviewer. The exported CSV files were analyzed using Biblioshiny (Bibliometrix), which can be accessed through RStudio (it is free to download at https://www.rstudio.com/products/rstudio/). The data consisted of institutional contributions, citations, co-authorship, and keyword co-occurrence. The thesaurus option of Microsoft Excel was then used to clean the data to minimize duplication and standardize similar words

Results

As shown in **Figure 1**, about 1900 articles were located in Scopus using the keywords serum and nanoemulsion OR hair growth. Scopus offers wide coverage and detailed information on research article data in different fields, with the most significant ones being biology and natural sciences.[12] Following the inclusion criteria, 585 articles were left to analyze.

Global Article Trends (2015-2025)

Table 1 shows the analysis of articles worldwide and the average number of citations per article using RStudio.

An average of 53.18 articles were published annually, with a mean of 20.28 citations per article.

Most articles were published in 2023 (87), 2024 (67), and 2025 (65). The average number of citations per article was the greatest in 2017, with 38.48 citations per article. This indicates that 42 articles published in the year were used at least 38 times in the later research. The articles showed an upward trend between 2015 and 2025, although there was a decrease in 2024 and 2025 relative to the preceding year. This tendency is connected with the increasing amount of research interest in nanoemulsion-based hair growth serums, indicating that the potential of these products to be used in a range of areas is already recognized to a greater extent.

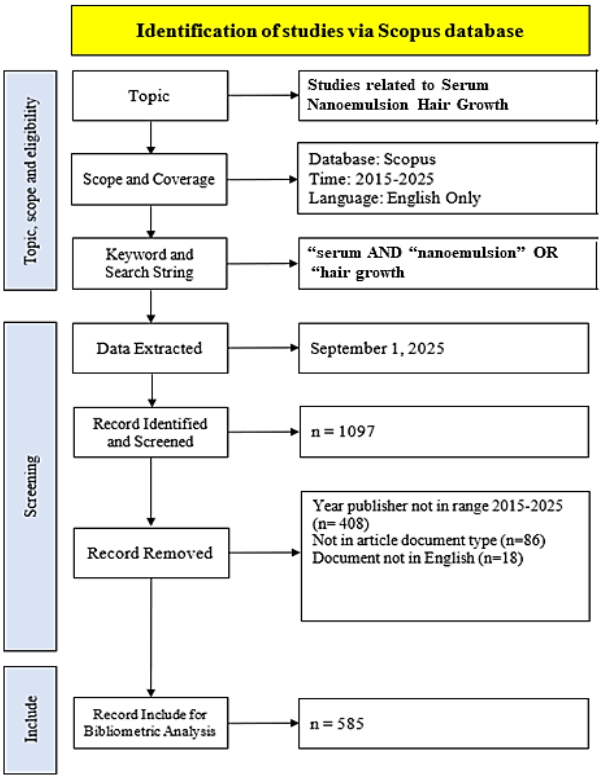

Figure 1 Flow diagram of the steps of article search.

Table 1 RStudio-based publication data trend by year.

Year	*Mean Citation per Article*	*Total Article*	*Mean Citation per Year*	*Total Citable Years*
2015	36.14	36	3.29	11
2016	34.08	26	3.41	10
2017	38.48	42	4.28	9
2018	27.44	34	3.43	8
2019	20.87	55	2.98	7
2020	19.49	49	3.25	6
2021	21.89	64	4.38	5
2022	13.03	60	3.26	4
2023	8.14	87	2.71	3
2024	2.64	67	1.32	2
2025	0.85	65	0.85	1
Average	20.28	53.18	3.01	6

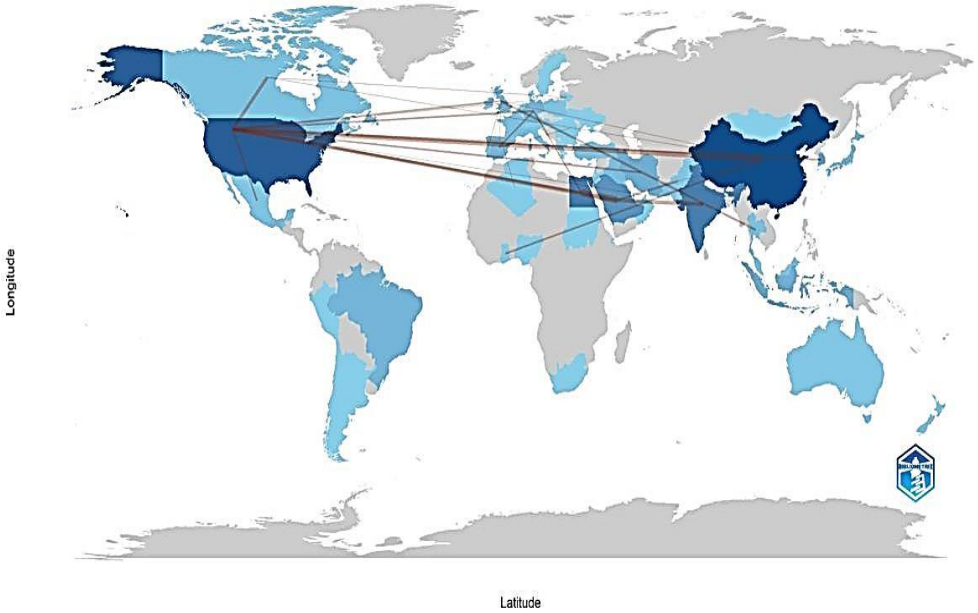

Figure 2 Country collaboration map from 2015 to 2025 using RStudio.

International Collaboration Networks

The international collaboration network among countries with at least five articles was analyzed using VOSviewer, and the analysis conducted with RStudio **(Figure 2)** illustrates the collaboration map among countries involved in research on nanoemulsion- based hair growth serums. The intensity of the blue color indicates the number of articles between 2015 and 2025, with darker shades representing higher research activity. Red lines represent collaborative relationships among authors from different countries. The distance between two nodes, or the length of the connecting line, reflects the similarity of research interests between countries. Shorter distances indicate closer alignment, whereas longer distances suggest differences in research focus.[13]

A total of five distinct clusters were identified from 71 countries that met the minimum threshold of five articles. Each cluster is represented by interconnected nodes (circles), while the strength of co-authorship and citation networks is indicated by the thickness of the connecting lines.[14] Larger nodes represent countries with higher article output compared to those with lower contributions. Overall, the United States (732), Saudi Arabia (463), and the United Kingdom (351) exhibited the highest total link strength.

Cluster 1 (red) consists of eight countries, with the United States and China showing the strongest collaboration networks, with total link strengths of 732 and 298, respectively. In Cluster 2 (green), Egypt and India exhibit the highest link strengths (347 and 275, respectively). Cluster 3 (blue) contains Iran and Iraq, which have overall link strengths of 142 and 36. Despite the fact that China tops in the number of articles, it has a low number of citations and link strength in comparison to other productive countries like the United States, Egypt, and Saudi Arabia. This indicates that scientists in China must intensify international cooperation to create a balance between the number of articles and citations.

Cluster 4 (yellow) points to Brazil, which has the best collaboration network with a total link strength of 67. Cluster 5 (purple) comprises Australia, Indonesia, Japan, and Malaysia. Although the majority of the 71 countries showed cooperative action, it is necessary to enhance links among lower-ranked and leading countries to assist in undertaking research on nanoemulsion-based hair growth serums.

Journal participation in research on Nanoemulsion-based hair growth serums (2015-2025)

Journal participation was analyzed using VOSviewer and is presented in **Table 2** and **Figure 3**, with further analysis conducted using RStudio. A total of 352 journals published research articles on nanoemulsion-based hair growth serums between 2015 and 2025. Among these, 18 journals met the minimum threshold of five articles. Journal of Cosmetic Dermatology and Pharmaceutics published the highest number of articles (14 each). This was followed by Journal of Drug Delivery Science and Technology (13 articles), Colloids and Surfaces B: Biointerfaces (9 articles), Animals, International Journal of Pharmaceutics, and International Journal of Applied Pharmaceutics (8 articles each).

In terms of average citations per journal, Drug Delivery ranked first with an average of 55.43 citations per article, followed by Colloids and Surfaces B: Biointerfaces (49.56) and International Journal of Pharmaceutics (46.00). Citation counts are a measure of the publicity and importance of research. The Journal of Cosmetic Dermatology and Pharmaceutics had the highest number of articles, and the main orientation was on cosmetic dermatology, which could justify its popularity in this field of research. Alternatively, Drug Delivery (Science Direct) had the highest citation rate, probably because of a wider focus, including formulation science, drug delivery technologies, and different administration routes that are meant to enhance drug efficiency, safety, and patient compliance. These peculiarities correlate with the design and use of nanoemulsion systems.

Table 2 Journals with at least 5 publications on serum nanoemulsion for hair growth.

Journal	*Total Publication*	*Total Citations*	*Average citation per Journal*
Journal of Cosmetic Dermatology	14	86	6.14
Pharmaceutics	14	183	13.07
Journal of Drug Delivery Science and Technology	13	197	15.15
Colloids And Surfaces B: Biointerfaces	9	446	49.56
Animals	8	58	7.25
International Journal Of Applied Pharmaceutics	8	18	2.25
International Journal Of Pharmaceutics	8	368	46.00
Drug Delivery	7	388	55.43
European Journal of Pharmaceutics and Biopharmaceutics	7	158	22.57
International Journal of Biological Macromolecules	7	132	18.86
International Journal of Nanomedicine	7	204	29.14

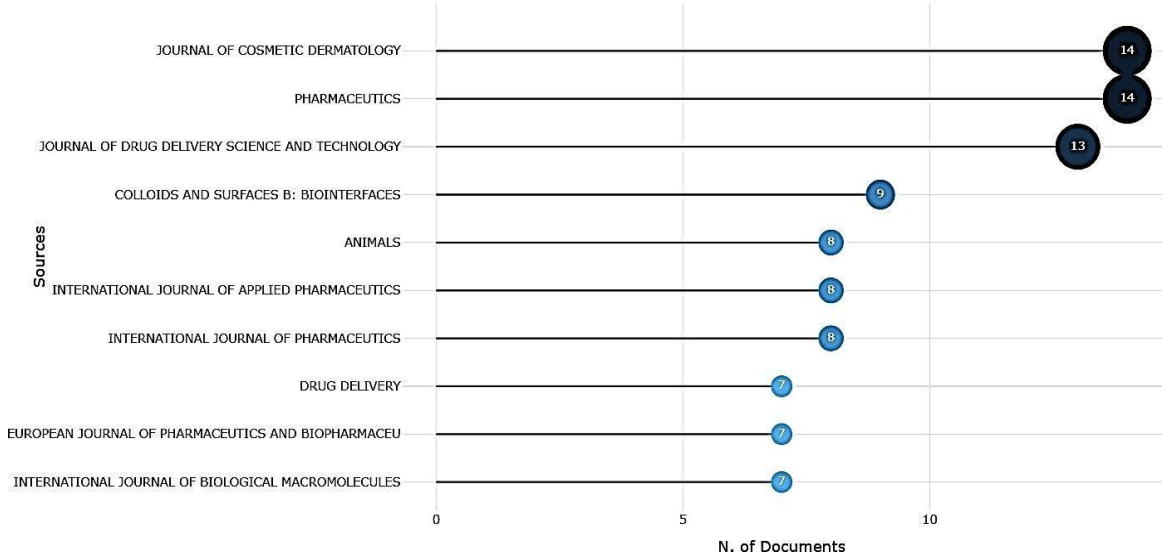

Figure 3 Most relevant sources on serum nanoemulsion hair growth.

Participation of the country in the research about the nanoemulsion-based hair growth serums (2015-2025)

Table 3 shows the results of global research participation by country, analyzed with VOSviewer. The table shows that 71 countries published relevant articles between 2015 and 2025. China ranked first with 105 articles and 1,927 citations, followed by the United States (100 articles, 2,351 citations), India (69 articles, 1,388 citations), Egypt (68 articles, 1,179 citations), and Saudi Arabia (49 articles, 879 citations). Although China had the highest number of articles, the United States achieved nearly twice the total citations of China with a comparable number of articles.

Table 3 Top 20 countries with most publications on Serum nanoemulsion for hair growth research

Country	*Documents*	*Total Citation*	*Average citation per publication*
China	105	1927	18.35
USA	100	2315	23.15
India	69	1388	20.12
Egypt	68	1179	17.34
Saudi Arabia	49	879	17.94
Iran	27	577	21.37
South Korea	24	512	21.33
UK	24	417	17.38
Indonesia	23	68	2.96
Brazil	22	484	22.00
Spain	20	549	27.45
Germany	19	305	16.05
Iraq	15	29	1.93
Thailand	12	115	9.58
Turkey	12	247	20.58
France	11	239	21.73
Japan	11	161	14.64
Taiwan	10	190	19.00
Italy	9	440	48.89
Portugal	9	131	14.56

Institutional and Affiliation Participation in Research on Nanoemulsion-Based Hair Growth Serums (2015-2025)

Institutional participation in research on nanoemulsion-based hair growth serums with a minimum threshold of 25 articles, is presented in **Table 4**.

A total of 1,155 institutions/ affiliations actively contributed to research outputs in this field, of which 25 institutions published at least five articles. The institution with the highest research output was the National Research Centre with 30 articles. This was followed by the Faculty of Science, King Abdulaziz University (8 articles), and three institutions with equal output of seven articles each: the Faculty of Pharmacy, King Abdulaziz University, the Faculty of Pharmacy, Cairo University, and the Faculty of Pharmacy, Ain Shams University.

Author participation (2015-2025)

Authorship analysis identified 3,315 authors contributing to research on nanoemulsion-based hair growth serums, as processed using VOSviewer

Table 4 Institutions with at least 25 publications on Serum nanoemulsion Hair Growth.

Affiliation	*Country*	*Total Publication*	*Total Citation*
National Research Centre, Giza	Egypt	30	548
Faculty Of Science, King Abdulaziz University	Saudi Arabia	8	196
Faculty Of Pharmacy, King Abdulaziz University	Saudi Arabia	7	48
Faculty Of Pharmacy, Cairo	Egypt	7	186
Faculty Of Pharmacy, Ain Shams University	Egypt	7	61
Universidade De São Paulo	Brazil	6	66
Faculty Of Veterinary Medicine	Egypt	6	52
National Organisation for Drug Control and Research, Egypt	Egypt	6	128
Jazan University	Saudi Arabia	6	138
Jamia Hamdard	India	6	238
Fudan University	China	6	98
Korea University	South Korea	6	124
Universidade De Sao Paulo	Brazil	6	66
Vellore Institute Of Technology	India	6	85

(Table 5). Only 12 authors met the minimum threshold of five articles within the 2015-2025 period. Among the most active authors are Mona Anwar El-Banna and Mehrez E. El-Naggar, each publishing seven articles. Mayson H. Alkhatib, Jihan Seid Hussein, Yasmin Abdel Latif, and Dalia Medhat, each having six articles, are other prominent authors. Furthermore, Rania F. Ahmed, Omar A. Farid Ahmed, and Raul Cavalcante Maranhao contributed five articles each. The analysis provides the average year of article and active years of research, showing that these scholars have been actively involved in the field.[15]

The analysis of author citation was carried out using the VOSviewer **(Table 4)**, which showed the top 10 contributors with the most citations. Mona Anwar El-Banna was first with 254 citations, followed by Mehrez E. El-Naggar (197 citations), and finally Dalia Medhat (136 citations). Citation analysis is a significant measure of scientific impact, as it shows the degree to which the work of an author is cited by other researchers.[17] It also shows the level of contributions made by authors and the associated organization. Mona Anwar El-Banna and Mehrez E. El-Naggar were significantly more concerned with nanoparticle formulation, pharmacology, toxicology, and biomedical applications, leading to the high number of citation rates, as the articles are interdisciplinary. Similarly, Dalia Medhat specialized in nanoemulsions and biochemistry, contributing to numerous citations. Other highly cited authors within the top 10 predominantly focus on nanoparticle formulation, biochemistry, and pharmacology.

Based on these findings, research quality, visibility, and impact cannot be assessed solely based on the number of articles. Instead, citation impact also reflects the breadth of research interest, interdisciplinary relevance, and level of global visibility.[15] **Table 4** shows that most leading authors in this field are established researchers with high h-index values, reinforcing their status as influential contributors to research on nanoemulsion-based hair growth serums.

Co-occurrence of Keywords by Authors in Research on Nanoemulsion-Based Hair Growth Serums (2015-2025)

Author keyword co-occurrence was analyzed using VOSviewer **(Figure 4)**. Keywords or terms that are repeatedly used by authors are referred to as "keyword co- occurrence in scientific articles." These keywords not only reflect current research trends but also enhance the visibility and discoverability of future investigations.[17] Among 9,005 keywords related to this sphere, 903 had five or more occurrences. The most frequently occurring terms were "article" (463), "controlled study" (349), "nanoemulsion" (321), "nonhuman" (287), and "human" (260). These are keywords that are most often included in author abstracts, suggesting the focus on issues related to formulation, pharmaceutics, and pharmacology is high.

Furthermore, link strength analysis showed that the article had the greatest total link strength (15,242), then controlled study (12,340), nanoemulsion (10,211), nonhuman (10,499), and human (8,244).

Table 5 Top 10 most cited authors on Serum nanoemulsion Hair Growth.

Author	*Total Publication*	*Total Citation*	*Average citation per publication*	*H index*
El-Banna Mona Anwar	7	254	36.29	5
El-Naggar Mehrez E.	7	197	28.14	5
Medhat Dalia	6	136	22.67	5
Hussein Jihan Seid	6	135	22.50	5
Latif Yasmin Abdel	6	135	22.50	5
Nasr Maha	6	124	20.67	4
Ahmed Rania F.	5	121	24.20	4
Ahmed-Farid Omar A.	5	121	24.20	4
Maranhäo Raul Cavalcante	5	62	12.40	5
Alkhatib Mayson H.	6	56	9.33	5

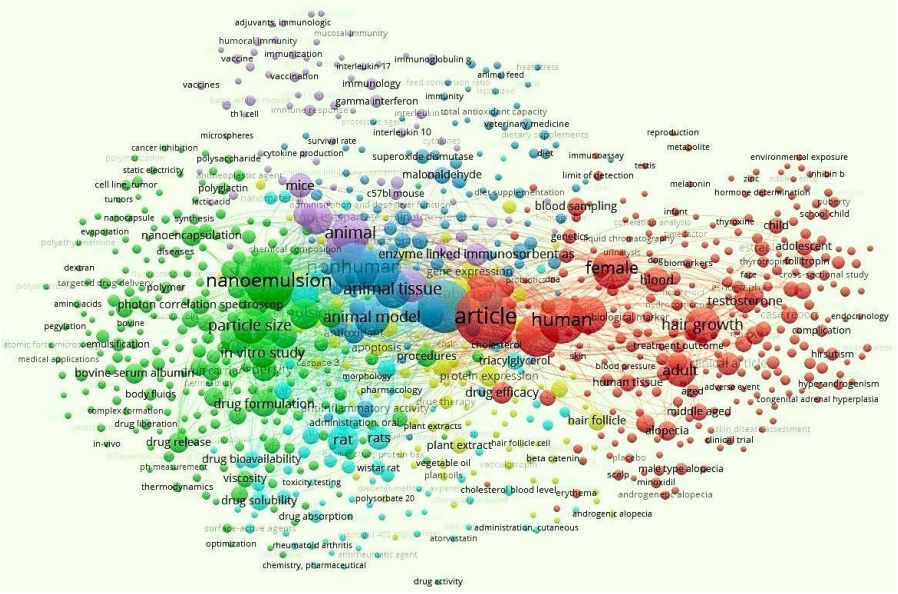

Figure 4 Network visualization of author's keyword with a minimum of 5 co-occurrences in publications on serum nanoemulsion for hair growth between the years 2015-2025.

These results indicate that most of the considered articles make extensive use of the terms, as they are at the heart of this area of research.

The cluster analysis showed six big thematic clusters, including Cluster 1: cosmetics, Alopecia, androgen, case-control study, dihydrotestosterone, drug efficacy, finasteride, genetics, hair growth. Cluster 2: chemical composition, drug delivery, emulsification, gel, human cells, lipids. Cluster 3: antioxidants, controlled study, nanotechnology. Cluster 4: water-in-oil cream, rats, animal studies. Cluster 5: nanostructures, rats, self- nanoemulsifying drug delivery systems (SNEDDS), toxicity testing.

Figure 5 shows a three-field plot between the most commonly mentioned references, authors, and keywords. Associations between these three dimensions are drawn in the gray lines, and the size of the rectangle shows the number of references, citations, or keyword frequency. **Figure 6** shows how the topics of research in terms of keywords that were used at least five times per year within 2015-2025 were changing over time and analyzed in

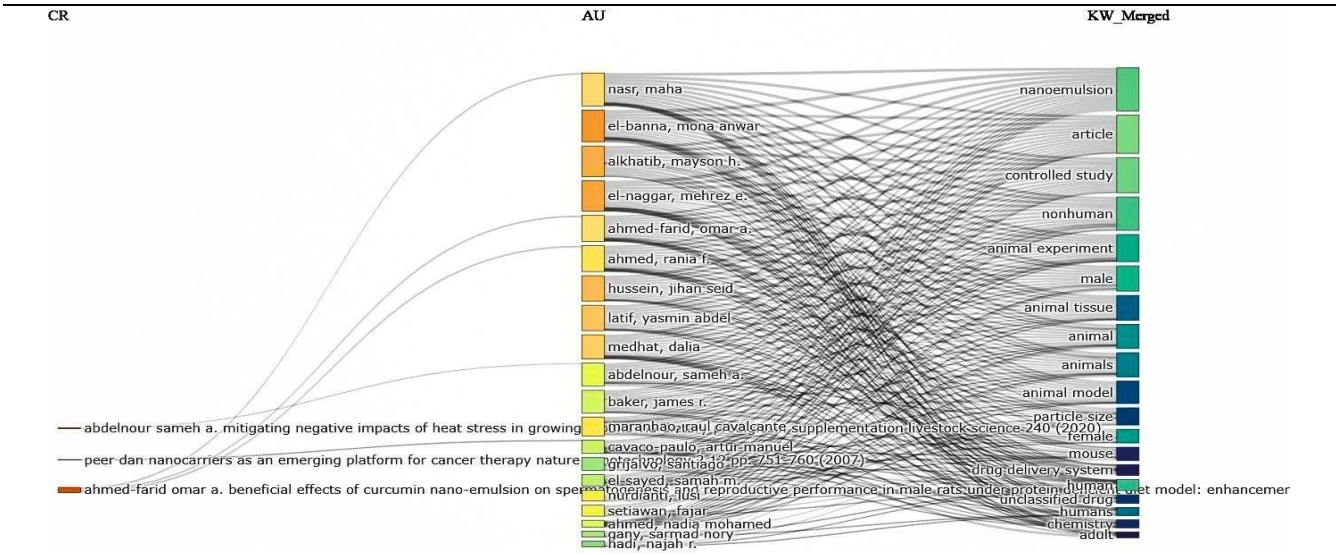

Figure 5 Three-fields plot between Cited References (CR), Authors (AU), and Keywords (KW Merged) using Rstudio.

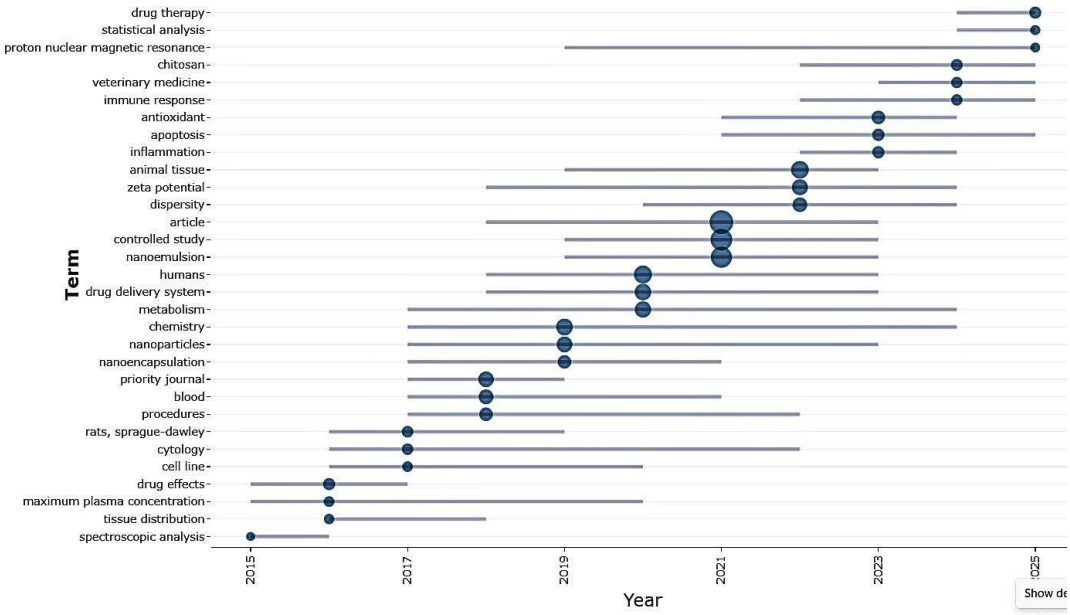

Figure 6 Trend topic using RStudio.

RStudio. The keyword nanoemulsion started to be more common in the period around 2019-2023, being an indicator of the appearance as a research theme.

Discussion

The research time frame was set to offer a wide view of trends and the new frontiers of research concerning nanoemulsion-based hair growth serums. In this research, the bibliometric analysis was used as a systematic literature review method that is applicable in the mathematical analysis of different scientific papers related to a given topic.[19] The results suggest that nanoemulsions have been an extremely active research field, especially with a great emphasis on preclinical applications. The literature is dominated by leading contributors like Ahmed-Farid and Abdelnour, and keywords such as drug delivery, animal models, and nanoemulsion have become the focus of scientific discussion **(Figure 6)**.

In comparison to the traditional emulsions, nanoemulsions have better stability.[19] Nanoemulsion increases the solubility of drugs with poor solubility in water, increases dispersion in watery conditions, stabilizes the oil-water ratio on the skin, and can be prepared without alcoholic solvents.[20] The majority of traditional topical products, in contrast, have active ingredients mixed with water and alcohol, which tend to poorly penetrate through the skin barrier. Therefore, only a small percentage of the drug attaches to target sites like hair follicle pores.[21] These restrictions help to lower clinical efficacy and poor patient adherence.[22] However, nanoformulations can penetrate and stay longer in hair follicles.[7] This system also decreases the dosage of the drug required, and in certain situations, side effects can be minimized or even prevented.

Limitation

In this research, not all articles might have been discovered, especially those that are not in English or are not listed in the selected database. This could offer the analysis some bias, but these attempts were made to cover all the data. Moreover, changing the spelling of the author and institution name may influence the precision of the data recognition. This research offers a representative report of the current trends on nanoemulsion-based hair growth serums, as well as provides pertinent details on how knowledge in this area can be advanced.

Conclusions

In conclusion, this bibliometric review shows that

the number of articles on the topic of nanoemulsion-based hair growth serums has increased significantly in the last decade. The main contributors are China and the United States, with the United States having a greater citation impact and a wider collaboration network. The National Research Centre of Egypt, as well as the pioneer authors in this field, like Mona Anwar El-Banna and Mehrez E. El-Naggar, contributed significantly to this field. Although these developments have been made, more needs to be achieved to transform the current research into clinically valid and commercially viable products. Future studies should focus on improving delivery systems, conducting comprehensive long-term safety evaluations, and implementing large-scale clinical trials. Enhanced international collaboration and multidisciplinary approaches will be essential to accelerating innovation and improving accessibility to effective hair growth treatments.

Financial support and sponsorship This work was supported by the Indonesian Education Scholarship (BPI), Center for Higher Education Funding and Assessment, Indonesia Endowment Fund for Education (LPDP) by number 0606/J5.1/LP.01.01/2023.

Conflict of interest There are no conflicts of interest.

Author's contribution

M,A: Substantial contribution to study design, acquisition of data, manuscript writing.

TH,AN,EN: Substantial contribution to analysis and interpretation of data, critical review of the manuscript.

AKN: Substantial contribution to concept, study design and critical review of the manuscript.

Every author has given final approval of the manuscript version to be published and agreed to be accountable for all aspects of the work.

References

1. Pinedo-Moraleda F, Tristán-Martín B, Dradi GG. Alopecias: Practical Tips for the Management of Biopsies and Main Diagnostic Clues for General Pathologists and Dermatopathologists. *J Clin Med*. 2023;12(15):5004. doi: 10.3390/jcm12155004. PMID: 37568407; PMCID: PMC10419566.
2. Sultana BB, Kumar Paul H. Efficacy and safety of platelet rich plasma therapy in male androgenetic alopecia. *J Pak Assoc Dermatol*. 2020;**30(3)**:375-81.
3. Gupta AK, Wang T, Economopoulos V. Epidemiological landscape of androgenetic alopecia in the US: An All of Us cross-sectional study. *PLoS One*. 2025;**20(2)**:e0319040. https://doi.org/10.1371/journal.pone.0319040
4. Abla KK, Alamoudi MK, Soliman GA, Abdel-Kader MS, Aldawsari MF, Mehanna MM. Alopecia Management Potential of Rosemary-Based Nanoemulgel Loaded with Metformin: Approach Combining Active Essential Oil and Repurposed Drug. *Int J Nanomedicine*. 2025;**20**:605-24.
5. Salau AK, Shehu MS, Adisa KO, Olanrewaju OI, Adeyemo AA. Nanoemulsion Drug Delivery Systems for Dermatological Disorders: A Review of Mechanisms, Clinical Applications and Commercial Advances. *UMYU Sci*. 2025;**4(2)**:175-92.
6. Rizg WY, Hosny KM, Elgebaly SS, Alamoudi AJ, Felimban RI, Tayeb HH, *et al*. Preparation and optimization of garlic oil/apple cider vinegar nanoemulsion loaded with minoxidil to treat alopecia. *Pharmaceutics*. 2021;**13(12)**:1–14.
7. Lademann J, Richter H, Teichmann A, Otberg N, Blume-Peytavi U, Luengo J, *et al*. Nanoparticles - An efficient carrier for drug delivery into the hair follicles. *Eur J Pharm Biopharm*. 2007;**66(2)**:159-64.
8. Donthu N, Kumar S, Mukherjee D, Pandey N, Lim WM. How to conduct a bibliometric analysis: An overview and guidelines. *J Bus Res* [Internet]. 2021;**133(March)**:285-96. https://doi.org/10.1016/j.jbusres.2021.04.070
9. Arifah FH, Nugroho AE, Rohman A, Sujarwo W. A bibliometric analysis of preclinical trials of Andrographis paniculata (Burm.f.) Nees in diabetes mellitus. *South African J Bot* [Internet]. 2022;**151**:128-43. https://doi.org/10.1016/j.sajb.2021.12.011
10. Fatimah SF, Lukitaningsih E, Martien R, Nugroho AK. Bibliometric analysis of articles on nanoemulsion and/or in-situ gel for ocular drug delivery system published during the 2011-2021 period. *Pharmacia*. 2022;**69(2)**:467-84.
11. Deveci E. Nanoemulsions in cosmetics: Enhancing efficacy and stability. *J Dermatologic Sci Cosmet Technol*. 2025;**2(3)**:100107.
12. Moral-muñoz JA; Herrera-Viedma, Enrique; Santisteban-Espejo, Antonio; Cobo, Manuel J. Software Tools for Conducting Bibliometric Analysis in Science: An up-to-Date Review. *Profesional de la información*. 2020;**29(1)**: e290103. https://doi.org/10.3145/epi.2020.ene.03.

13. Zakaria N, Abdullah NAC, Zahoor N, Azizan M, Syed ZA. A Bibliometric Analysis of Quality of Work-Life: Current Status, Development, and Future Research Directions. *Pakistan J Life Soc Sci*. 2024;**22(2)**:326-47. https://doi.org/10.1016/j.jbusres.2019.11.025
14. van Eck NJ, Waltman L. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*. 2010;**84(2)**:523-38.
15. George TT, Obilana AO, Oyenihi AB, Rautenbach FG. Moringa oleifera through the years: a bibliometric analysis of scientific research (2000-2020). *South African J Bot*. 2021;**141**:12-24. https://doi.org/10.1016/j.sajb.2021.04.025
16. Salmerón-Manzano E, Garrido-Cardenas JA, Manzano-Agugliaro F. Worldwide research trends on medicinal plants. *Int J Environ Res Public Health*. 2020;**17(10)**:3376. doi:10.3390/ijerph17103376
17. Omoregbe O, Mustapha AN, Steinberger-Wilckens R, El-Kharouf A, Onyeaka H. Carbon capture technologies for climate change mitigation: A bibliometric analysis of the scientific discourse during 1998-2018. *Energy Reports*. 2020;**6**:1200-12. https://doi.org/10.1016/j.egyr.2020.05.003
18. Sumardi, Masfria, Basyuni M, Septama AW. Potential of Polyisoprenoid of Mangroves as Antimicrobial and Anticancer: A Bibliometric Analysis. *Sci Technol Indones*. 2022;**7(1)**:22-28. https://doi.org/10.26554/sti.2022.7.1.22-28
19. Wan Y, Nor K Bin, Lyu B, Feng W. Bibliometric Analysis of Global Research Trends on Social Presence Using Scopus Database. *Int J Ind Eng Prod Res*. 2023;**34(4)**:51-60. https://doi.org/10.1016/j.bej.2018.05.002
20. Upadhyay DK, Sharma A, Kaur N, Gupta G Das, Narang RK, Rai VK. Nanoemulgel for Efficient Topical Delivery of Finasteride Against Androgenic Alopecia. *J Pharm Innov*. 2021;**16(4)**:735-46. https://doi.org/10.1007/s12247-020-09483-9
21. Roque LV, Dias IS, Cruz N, Rebelo A, Roberto A, Rijo P, *et al*. Design of Finasteride-Loaded Nanoparticles for Potential Treatment of Alopecia. *Skin Pharmacol Physiol*. 2017;**30(4)**:197-204. doi: 10.1159/000475473
22. Schreiner TB, Santamaria-Echart A, Ribeiro A, Peres AM, Dias MM, Pinho SP, *et al*. Formulation and optimization of nanoemulsions using the natural surfactant saponin from Quillaja bark. *Molecules*. 2020;**25(7)**:1538. doi:10.3390/molecules25071538.