Research Hotspots and Trends of Chinese Herbal Formula Shampoo Products in China from 2005 to 2025: Bibliometric Analysis Based on CiteSpace

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Abstract [**Objectives**] Based on bibliometric methods, the evolution path and knowledge structure of shampoo product research in China were systematically analyzed, with a focus on the composition, efficacy, and mechanisms of traditional Chinese medicine shampoos, aiming to reveal the shifting patterns of core technological focuses at different stages and identify key future research directions. [**Methods**] Using a sample of 515 publications from CNKI journals between 2005 and 2025, CiteSpace 6.3.R1 was employed to construct multi-dimensional networks of authors, institutions, and keywords. Burst detection, keyword and cluster analyses, and time zone mapping were applied to track disciplinary dynamics. [**Results**] The analysis on the annual number of publications indicated that research on shampoo products underwent multiple phases including initial development, growth, fluctuation, peak, and adjustment from 2005 to 2025, with an overall upward trend. The significant differences between the collaboration network density of core authors and the strength of institutional cooperation indicated a need for academia to enhance cross-institutional collaborative innovation mechanisms. Keyword clustering analysis and co-occurrence mapping revealed that the research on traditional Chinese medicine shampoo products, known for their natural, mild, and non-irritating characteristics, demonstrates notable advantages in dandruff removal, anti-hair loss, hair growth, and scalp health management, which have become current research hotspots, providing data-driven decision-making support for technological upgrading and industry-academia-research integration in the field. [**Conclusions**] The bibliometric analysis based on 515 publications indicates that the overall development direction of shampoo products will comprehensively advance toward refined efficacy and personalized customization, greener and more natural ingredients, technological innovation and industry-academia-research collaboration, market segmentation and diversified development, as well as safety and efficacy evaluation. This study provides theoretical support for the innovation of specialized traditional Chinese medicine shampoo products.

Key words Shampoo products; CiteSpace; Bibliometric analysis; Traditional Chinese medicine shampoo; Knowledge graph; Ingredient analysis; Efficacy evaluation; Mechanism research

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As the world's largest consumer market for shampoo products, China's shampoo industry reached a market size of over 58 billion yuan in 2023, accounting for 34.7% of the market share of personal care products. Its technological evolution and consumption upgrading are of strategic significance to the high-quality development of the daily chemical industry[1]. The industry currently exhibits dual characteristics of "high penetration" and "intense competition". On the one hand, data from Euromonitor shows that the average number of brands displayed per store in domestic supermarket channels reached 23 in 2023, with foreign brands maintaining a market share of over 65% for an extended period. On the other hand, consumers' efficacy demands continue to diversify, with 62.8% of surveyed respondents prioritizing "scalp health management" as a core purchasing criterion, driving product development toward refined functions and greener ingredients[2]. Despite continuous expansion of the industry scale, a significant knowledge gap persists between academic research and industrial practice. Existing literature predominantly focuses on isolated technical domains, lacking systematic deconstruction of disciplinary evolution patterns. Furthermore, as consumers place greater emphasis on scalp health management and embrace green, natural consumption concepts, herbal shampoos have gained increasing market preference due to their unique ingredients and efficacy. In the field of academic research, studies on herbal shampoo products have progressively deepened, encompassing various aspects such as analysis of herbal ingredients, efficacy evaluation, and product development. However, there is currently relatively little systematic sorting and analysis in this field. In this study, the CiteSpace bibliometric tool was employed to conduct a visual analysis of 515 core publications from 2005 to 2025, aiming to systematically trace the evolution of research hotspots in shampoo products, particularly herbal shampoo products, over the past two decades. It seeks to reveal the shifting patterns of core technological focuses at different stages, identify key future research directions, and provide theoretical foundations and practical guidance for achieving core technological independence and enhancing international competitiveness in China's daily chemical industry.

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Louxin LIANG (2002-), female, devoted to research about effects of pharmaceutical ingredients.

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Research Methods and Data Collection

The China National Knowledge Infrastructure (CNKI) was selected as the platform for acquiring literature data in this study.

Leveraging its comprehensive and authoritative repository, the database enables precise bibliometric processing and analysis of diverse scientific literature data through CiteSpace, thereby providing robust support for predicting development hotspots and frontier directions in specific academic research fields[3]. In terms of retrieval strategy, advanced search was selected with the search condition set to subject term retrieval. The search was conducted based on the performance, efficacy, ingredients, mechanism of action, and manufacturing processes of shampoo products, with particular attention to research related to "herbal shampoos". The time frame was limited to 2005 – 2025, and journal sources included all publications. A total of 731 documents were retrieved. After literature screening, 515 documents highly relevant to the research topic were ultimately identified as the sample for this study. The CiteSpace V. 6. R1 software was employed to conduct an in-depth analysis on key elements in the sample, including the number of publications, author distribution, research institutions, and keywords. Corresponding knowledge graphs were generated to systematically and comprehensively present the research status, core hotspots, and future development trends in the field of shampoo products. The results were analyzed, with particular attention being paid to the ingredients, efficacy, and mechanisms of herbal shampoos.

Bibliometric Analysis of Shampoo Product Research

Bibliometric analysis on annual number of publihsed papers

The annual number of publihsed papers and its trend changes in a specific research field reflect the development and level of academic attention, which is of great significance for analyzing and predicting future research trends[4]. Based on the selected valid data literature database, the trend chart of publication number was obtained (as shown in Fig. 1). Overall, the number of publications in the field of shampoo products shows an upward trend, with a certain number of publications every year, indicating that academic research on shampoo products continues to attract sustained attention, which is related to the essential role of shampoo products in people's daily lives. Based on the statistical analysis on the annual number of published papers, research on shampoo products in China could be broadly divided into six stages. In specific, the period from 2005 to 2011 was an initial research and gradual growth phase. The publication count was 10 papers in 2005, followed by a steady annual increase, reaching 31 papers by 2011. The period from 2012 to 2016 represented a fluctuating development and diversified research phase. The publication count reached a minor peak of 36 papers in 2012, declined to 21 in 2013, then rebounded to 32 in 2015, and dropped again to 21 in 2016, showing a fluctuating pattern. During the period of 2017 and 2019, the number of publications was stabilized between 21 and 25 papers, with a rise to 28 in 2019, indicating a relatively steady phase overall. 2020 was a peak research phase. The publication count reached 43 papers in 2020, the highest value in the entire period. The period from 2021 to 2024 was a fluctuating adjustment phase. The publication trend showed 34 papers in 2021, followed by a decline to 27 in 2022, a rebound to 34 in 2023, and 28 in 2024, indicating certain fluctuations. In 2025, the research activity entered a phase of declining interest, with the number of publications dropping significantly to 10 papers, marking a noticeable decrease. The significant decline in the number of published papers may indicate a temporary reduction in research interest in this field or a shift in research focus.

Analysis of keyword betweenness centrality and co-occurrence mapping

Keyword frequency reflects the research interest to some extent, while the betweenness centrality of nodes indicates the magnitude of their connecting role within the network. A higher betweenness centrality value (>0.1) suggests that the keyword acts as a pivotal hub in the network[5]. Using CiteSpace for calculation of betweenness centrality and ranking the results (Table 1), keywords such as "hair cleanser", "conditioner" and "hair shampoo" were excluded, and the top five keywords were "repair", "traditional Chinese medicine", "efficacy", "Chinese herbal medicine", and "Cacumen Platycladi". Keywords, as a highly refined summary of the research findings by authors, can intuitively capture the central theme of an article. Their correlation, frequency and burstiness can reflect the long-term research hotspots, internal connections, and development trends within a field, facilitating a comprehensive understanding of the research topic[6]. In this study, keyword co-occurrence mapping was adopted to conduct a systematic analysis of shampoo product research, aiming to uncover research hotspots and predict future research directions.

Overall, as shown in (Fig. 2), research hotspots in shampoo products covering functional development, ingredient studies, scalp health, and market trends were revealed. It provides directional guidance for future research and reflects the field's emphasis on meeting consumer demands and aligning with market realities.

Table 1 Keywords with betweenness centrality >0.1

No.	Frequency	Betweenness centrality	Keywords
1	113	0.53	Hair lotion
2	3	0.45	Hair conditioner
3	3	0.41	Repair
4	10	0.32	Traditional Chinese medicine
5	6	0.32	Efficacy
6	6	0.22	Cacumen Platycladi
7	8	0.19	Chinese herbal medicine
8	6	0.19	Market
9	18	0.18	Hair shampoo
10	11	0.18	Dandruff removal
11	2	0.18	Anti-hair loss
12	2	0.18	Hair care product
13	9	0.14	Cosmetics
14	7	0.14	Shampoo
15	3	0.11	Selenium sulfide

Keyword clustering analysis

Research clustering map is a thematic map generated through further refinement and summarization based on keyword mapping, which visually presents major research areas[7]. Typically, when the *Q*-value exceeds 0.3, the generated clustering map can be considered to have significant structural features and rationality; and an *S*-value above 0.7 indicates high credibility of the clustering results[8]. In the context of this analysis, the *Q*-value of the clustering map was 0.92 and the *S*-value was 0.979 1. As shown in Fig. 3, these two indices not only fell within the widely accepted reasonable range but also significantly exceeded conventional thresholds, fully demonstrating that the keyword clustering results are highly reliable and convincing. Keywords of the same color in the figure belong to the same cluster. A total of 13 main clusters were identified, namely #0 shampoo product, #1 *Malassezia*, #2 traditional Chinese medicine, #3 hair growth, #4 shampoo, #5 bamboo charcoal, #6 market, #7 hair lotion, #8 hair conditioner, #9 performance, #10 Chinese herbal medicine, #11 combability, and #12 hair. These clusters collectively reflect the research hotspots in the field of shampoo products.

Bibliometric analysis of burst terms

Keyword burst analysis can reflect the popularity of specific research directions within a field, indicating research frontiers and hotspots[9]. As shown in Fig. 4, the light-colored lines in the figure represent time intervals, while the dark-colored lines indicate the duration of burst keywords. The two ends of each dark-colored line mark the start and end of the corresponding burst time interval[10].

As shown in Fig. 4, from a temporal perspective, the evolution could be broadly divided into three stages. In the early stage (approximately from 2005 to 2013), research hotspots focused on basic concepts and traditional ingredients such as "Chinese herbal medicine", "shampoo", "hair shampoo", and "hair lotion". The burst of "Chinese herbal medicine" from 2005 to 2009 indicated that leveraging herbal ingredients in shampoo product development was a key research focus during this period. During the mid-term phase (approximately from 2011 to 2020), keywords such as "synthesis", "thickening", "active ingredients", and "formula" experienced bursts, while research related to "anti-dandruff agents" and "cosmetics" also increased. In the recent phase (from 2019 to 2025), topics such as "application performance", "efficacy evaluation", "flocculation", and "irritating" emerged as hotspots. The continued bursts of "traditional Chinese medicine" and "preparation technology" indicate that the optimization of traditional ingredients and processes remains a key research focus.

Timeline mapping analysis

Overall research trends and thematic distribution As shown in Fig. 5, lines and nodes of different colors in the map represent distinct research themes. Keywords appearing on the timeline indicate their first occurrence at a specific time, while the size of the nodes reflects the frequency of keyword appearances. Lines represent keyword co-occurrence. The vertical axis displays cluster names, and the horizontal axis represents the timeline, illustrating changes in research popularity of vairous themes over different periods[11]. It could be observed that research on shampoo products encompasses multiple key themes, such as shampoo, *Malassezia*, traditional Chinese medicine, hair growth, hair shampoo, hair conditioner, and Chinese herbal medicine. These themes exhibit distinct developmental trends along the timeline.

Developmental changes along the time dimension From a temporal perspective, the research hotspots of different themes have fluctuated over time. Early research primarily focused on the basic ingredients and functions of shampoo, such as themes #0 shampoo and #6 market, which emerged early and continued to develop. Keywords such as "formulation research", "antibacterial" and "anti-dandruff" also appeared during this period. In the mid-term phase, research gradually expanded into more specific areas over time, such as themes #1 *Malassezia*, #2 traditional Chinese medicine, and #3 hair growth. Keywords such as "hair growth and darkening" and "*in-vitro* antibacterial activity" reflected a growing focus on the functions of shampoo products and natural ingredients. In the recent phase, research hotspots include themes #10 Chinese herbal medicine, #11 combability, and #12 hair. Keywords such as "microecology", "repair" and "oxidative stress" indicate a current emphasis on in-depth studies of hair health and care.

Conclusions and Discussion

Research hotspots in shampoo products

Research on traditional Chinese medicine shampoo products

The development of traditional Chinese medicine shampoo products demonstrates vigorous vitality and broad prospects. In recent years, with consumers' increasing pursuit of natural and healthy products and the widespread promotion of traditional Chinese medicine culture, the market for traditional Chinese medicine shampoos has rapidly emerged, becoming a new favorite in the hair care field. The market for traditional Chinese medicine shampoos is currently in a phase of rapid growth and is expected to continue expanding in the coming years, becoming a significant force in the hair care market[12]. Traditional Chinese medicine shampoo products, known for their natural, mild, and non-irritating characteristics, demonstrate remarkable advantages in dandruff removal, anti-hair loss, hair growth, and scalp health management. Furthermore, leveraging traditional Chinese medicine theories and integrating modern technology, these products incorporate carefully selected Chinese herbs such as *Salvia miltiorrhiza*, *Angelica sinensis*, *Panax ginseng*, and *Polygonum multiflorum*. Through multiple pathways including nourishing the liver and kidneys, promoting blood circulation and removing stasis, tonifying the kidneys and essence, dispelling wind and dampness, and clearing away heat and toxic materials, they comprehensively improve the scalp environment and effectively address issues such as hair loss, dandruff, and scalp inflammation[13-15]. Modern research has not only validated the significant efficacy of traditional Chinese medicine ingredients in promoting hair growth, regulating sebum secretion, and providing antibacterial and anti-inflammatory benefits[16-18], but has also enhanced the permeability and therapeutic effects of these shampoos through innovative approaches such as nanotechnology and microbiome regulation. Meanwhile, the rise of personalized

customization services enables traditional Chinese medicine shampoos to offer precise solutions tailored to different consumers' scalp types and hair loss causes, meeting diverse needs.

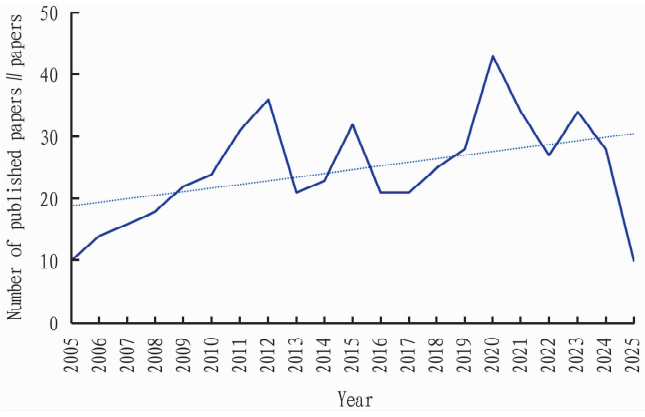


Fig. 1 Number and trend of papers published on shampoo products from 2005 to 2025

Fig. 2 Co-occurrence map of research keywords of shampoo products from 2005 to 2025

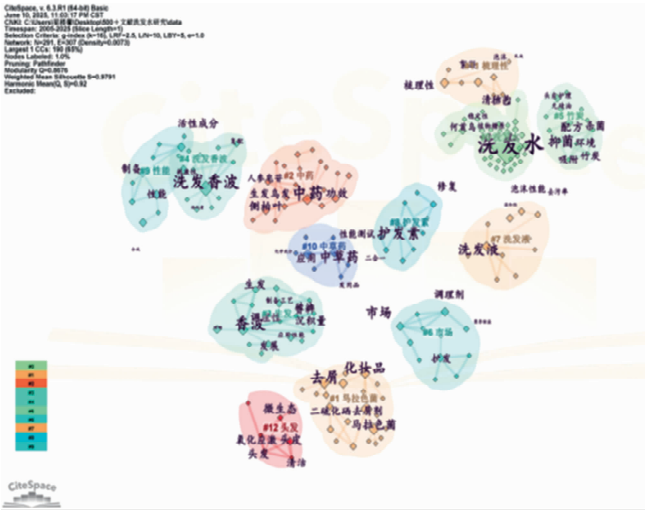
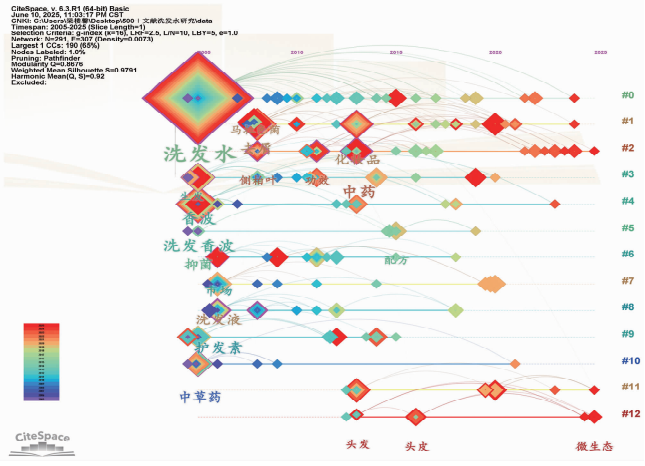


Fig. 3 Keyword clustering map of shampoo research from 2005 to 2025

Top 21 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2005–2025
Chinese herbal medicine	2005	2.94	2005	2009	
Market	2006	2.11	2006	2013	
Hair lotion	2006	1.73	2006	2011	
Shampoo	2005	2.02	2008	2012	
Repair	2008	1.59	2008	2011	
Hair conditioner	2009	2.44	2009	2012	
Liquid shampoo	2005	3.03	2011	2012	
Synthesis	2012	2.29	2012	2013	
Thickening	2014	1.72	2014	2020	
Active ingredient	2014	1.67	2014	2015	
P. multiflorum	2015	2.22	2015	2017	
Formula	2015	1.83	2015	2019	
Anti-dandruff agent	2008	1.71	2017	2022	
Cosmetics	2013	1.65	2017	2021	
Application performance	2019	2.03	2019	2021	
Efficacy evaluation	2020	3.13	2020	2023	
Flocculation	2020	1.76	2020	2025	
Irritating	2013	1.58	2021	2022	
Traditional Chinese medicine	2013	2.41	2022	2023	
Preparation process	2011	1.65	2022	2023	
Malassezia	2008	2.27	2023	2025	

Fig. 4 Keyword burst map in shampoo research from 2005 to 2025



#1. Hair cleanser; #2. *Malassezia*; #3. Traditional Chinese medicine; #4. Hair shampoo; #5. Bamboo charcoal; #6. Market; #7. Hair lotion; #8. Hair conditioner; #9. Performance; #10. Chinese herbal medicine; #11. Combability; #12. Hair.

Fig. 5 Keyword timeline map of shampoo research from 2005 to 2025

Research on chemical composition and functional efficacy In recent years, as consumers' demands for the efficacy and safety of shampoo products have increasingly grown, research on the chemical composition of shampoos has gradually become a hotspot. Based on the results of CiteSpace mapping analysis and practical development, the chemical components of shampoo products can be broadly categorized into four major types: surfactants, functional additives, natural plant extracts, and special efficacy ingredients. Each type possesses its unique functional properties and benefits.

Innovation and trends in the shampoo product industry

In this study, the CiteSpace bibliometric analysis software was employed to systematically reveal the research evolution and hotspot shifts in China's shampoo product industry over the past two decades by drawing knowledge graphs of publication number, authors, institutions, and keywords. It further uncovered the shifting patterns of core technological focuses in different stages. From

initial research on cleansing functions, studies have progressively expanded to diverse efficacy areas such as dandruff removal, anti-hair loss, hair growth, nourishing and repair, and oil control. This reflects the continuous deepening and specialization within shampoo product research. Studies indicate that traditional Chinese medicine shampoos, known for their natural, mild, and non-irritating characteristics, have gradually become a research hotspot. In-depth investigations have explored the efficacy and mechanisms of Chinese herbal ingredients such as *S. miltiorrhiza*, *A. sinensis*, *P. ginseng*, and *P. multiflorum* in addressing dandruff, preventing hair loss, promoting hair growth, and managing scalp health[19]. With increasing market recognition of traditional Chinese medicine shampoo products, research on their efficacy evaluation and mechanisms of action has also deepened. The chemical components of shampoo products can be broadly categorized into four major types: surfactants, functional additives, natural plant extracts, and special efficacy ingredients. In recent years, significant progress has been made in the study of the functional efficacy of shampoo products. Research on anti-dandruff function not only focuses on antibacterial effects but also delves into its mechanisms of action. With the diversification of consumer demands, the shampoo product market has become further segmented. Beyond traditional efficacy, products targeting specific demographics and particular needs have emerged. Shampoo product enterprises must develop more refined offerings based on the varying needs of different consumers[20]. Technological innovation in the shampoo product industry is concentrated on enhancing product efficacy, safety, and user experience. Overall, the development direction of shampoo products will comprehensively advance toward refined efficacy and personalized customization, greener and more natural ingredients, technological innovation and industry-academia-research collaboration, market segmentation and diversified development, as well as safety and efficacy evaluation. These trends will drive continuous progress in the shampoo product industry, meeting consumers' growing health demands.

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