

## **Bibliometric Analysis of Herbal Treatments for Male Infertility: Trends, Efficacy, and Future Directions**

**Dona Suzana<sup>1</sup>, Kintoko<sup>2</sup>, Lalu Muhammad Ilham<sup>2</sup>, Moch. Saiful Bahri<sup>2</sup>, Teguh Arie Sandy<sup>3</sup>**

<sup>1</sup>Universitas Gunadarma, Indonesia

<sup>2</sup>Universitas Ahmad Dahlan, Indonesia

<sup>3</sup>Universitas Negeri Yogyakarta, Indonesia

Corresponding Author: Dona Suzana, Email: dona.suzana12@gmail.com

### **KEYWORDS**

Male infertility, herbal treatments, bibliometric analysis, oxidative stress, reproductive health.

### **ABSTRACT**

Male infertility, which affects approximately 7% of men worldwide, contributes significantly to overall infertility rates. This condition stems from complex genetic, hormonal, and environmental factors. Conventional treatments, including pharmacological and surgical options, often have limited efficacy and can cause adverse side effects, prompting growing interest in alternative treatments, particularly herbal medicine. This bibliometric analysis investigates trends, efficacy, safety, and future directions in the use of herbal treatments for male infertility. Using Scopus data and Biblioshiny for network visualization, the analysis evaluates publication trends, geographical and institutional contributions, funding sources, and the primary themes addressed in the field up to 2024. Findings indicate increasing research interest, particularly in China, Iran, and India, where traditional medicine systems like Traditional Chinese Medicine and Ayurveda are culturally significant. Despite promising results, especially from herbs such as *Withania somnifera* and *Tribulus terrestris*, the field lacks standardized formulations and rigorous clinical trials that confirm these remedies' efficacy and safety. This study highlights the need for standardized methodologies and expanded international collaborations to ensure the global applicability of findings. Further research is essential to integrate these herbal treatments effectively into mainstream medical practices, offering culturally sensitive and scientifically validated treatment options.

## **1. Introduction**

Male infertility is a significant global health issue, affecting approximately 7% of men and contributing to nearly half of all infertility cases worldwide (Barratt et al., 2017). The causes of male infertility are multifaceted, involving genetic abnormalities, hormonal imbalances, lifestyle factors, and environmental exposures (Smith et al., 2010). Conventional treatments typically include pharmacological and surgical interventions aimed at addressing these underlying causes. However, the limitations, side effects, and costs associated with these treatments have driven a growing interest in alternative and complementary therapies, particularly herbal medicine, which has been used for centuries in traditional practices across various cultures (Lampariello et al., 2012).

Herbal medicine offers a unique and promising approach to managing male infertility through the use of natural compounds found in plants that have demonstrated therapeutic properties. These bioactive compounds, such as flavonoids, alkaloids, and saponins, are believed to improve sperm quality, enhance hormonal regulation, and reduce oxidative stress—a key factor in male infertility (Hong et al., 1992). Several studies have highlighted the potential of specific herbs, such as *Withania somnifera* (Ashwagandha) and *Tribulus terrestris*, in improving sperm parameters and overall reproductive health in men (Qian et al., 1988; Wang et al., 2018). Despite the growing body of research supporting the use of herbal medicine in treating male infertility, there remains a need for more rigorous scientific validation. Many studies to date have been conducted on small sample sizes or lack proper controls, which limits the generalizability of their findings (Abd El-Wahab et al., 2013). Moreover, the exact mechanisms by which these herbs exert their effects are not fully understood, necessitating further investigation into their pharmacological actions and interactions with conventional treatments (Maimoona et al., 2011).

Bibliometric analysis provides a powerful tool for quantitatively assessing the research landscape and understanding the development of scientific knowledge in this field. By examining publication trends, document types, funding sources, and subject areas, researchers can gain insights into the focus, impact, and evolution of research on male infertility herbal treatments (Smith et al., 2010). This article aims to provide a comprehensive bibliometric review of the current state of research on herbal treatments for male infertility, synthesizing findings

from various studies to assess the efficacy and safety of these herbal remedies. Additionally, this review will highlight the gaps in the literature and propose directions for future research to ensure that herbal medicine can be effectively integrated into clinical practice (Lans, 2007).

One of the critical areas of focus in this review is the safety profile of herbal treatments for male infertility. While many herbs are considered safe when used appropriately, there is a risk of adverse effects, particularly when herbs are used in high doses or in combination with other medications (Otieno et al., 1991). The potential for herb-drug interactions is a significant concern that must be addressed through careful study design and patient monitoring (Lampariello et al., 2012). Furthermore, the standardization of herbal extracts and the quality control of herbal products are essential to ensure consistent therapeutic outcomes (Maimoona et al., 2011).

In addition to evaluating the efficacy and safety of herbal treatments, this article will explore the cultural and socio-economic factors that influence the use of herbal medicine for male infertility. In many regions, particularly in developing countries, herbal remedies are more accessible and affordable than conventional treatments (Lans, 2007). Understanding the cultural context in which these remedies are used can provide valuable insights into their acceptance and potential for integration into mainstream healthcare systems. This cultural perspective is crucial for developing holistic treatment strategies that are both effective and culturally sensitive.

Finally, this review will consider the potential for innovation in the field of male infertility treatment through the development of new herbal formulations and the application of modern technologies, such as nanotechnology, to enhance the delivery and efficacy of herbal compounds (Abd El-Wahab et al., 2013). By bridging the gap between traditional knowledge and modern science, there is an opportunity to create more effective and accessible treatments for male infertility. This approach could lead to the discovery of novel therapeutic agents and the optimization of existing herbal remedies for better clinical outcomes (Hong et al., 1992).

Overall, this bibliometric analysis aims to map the current research landscape of male infertility herbal treatments, providing a detailed overview of the key trends, challenges, and future directions in this rapidly evolving field. Through this comprehensive review, we hope to contribute to the growing body of knowledge on herbal medicine and its role in addressing one of the most challenging aspects of reproductive health.

## **2. Methods**

The methods for our bibliometric analysis of male infertility and herbal treatments began with comprehensive searches across Scopus. These databases were selected for their broad coverage of both peer-reviewed medical literature and herbal medicine studies, allowing for an in-depth exploration of relevant research outputs (Donthu et al., 2021; Van Eck & Waltman, 2010). The search strategy incorporated keywords such as "male infertility" and "herbal treatments" and was conducted up until May 17, 2024, without restrictions on the start date to ensure a full historical perspective (Kirby, 2023).

Inclusion criteria for the study were strict, encompassing peer-reviewed articles, conference papers, and review articles that directly discussed herbal treatments for male infertility and were available in English. Exclusion criteria eliminated non-peer-reviewed writings, duplicates, and studies not directly focused on male infertility and herbal treatments. Data were meticulously extracted using a standardized form that captured essential information such as publication year, authors, article title, journal name, citation count, and main conclusions about the efficacy and safety of the treatments (Kumar et al., 2024).

Bibliometric analysis was performed using Biblioshiny for network visualization and mapping, facilitating the identification of predominant themes, authorship patterns, and collaborative networks (Van Eck & Waltman, 2010). This analysis included examining publication frequency trends over time and citation data to determine the significant studies' impact and influence within the field. Furthermore, co-authorship and collaboration analysis were employed to uncover patterns among authors and map the geographic distribution of the research contributions. The methodological rigor of the included studies was assessed based on design, sample size, and the clarity of reported outcomes to ensure reliability and validity. All data analyzed were sourced from publicly available records, adhering to ethical standards for secondary data analysis. This methodological framework supports a systematic, replicable approach to understanding the evolving landscape of herbal treatments for male infertility (Nandiyo et al., 2021).

### 3. Results

The bibliometric analysis of research on herbal treatments for male infertility highlights significant trends, geographical distributions, and thematic focuses within the field. This study delves into the evolution of the scientific landscape surrounding this alternative treatment modality, offering insights into the breadth of research, key contributors, and potential gaps in current knowledge.

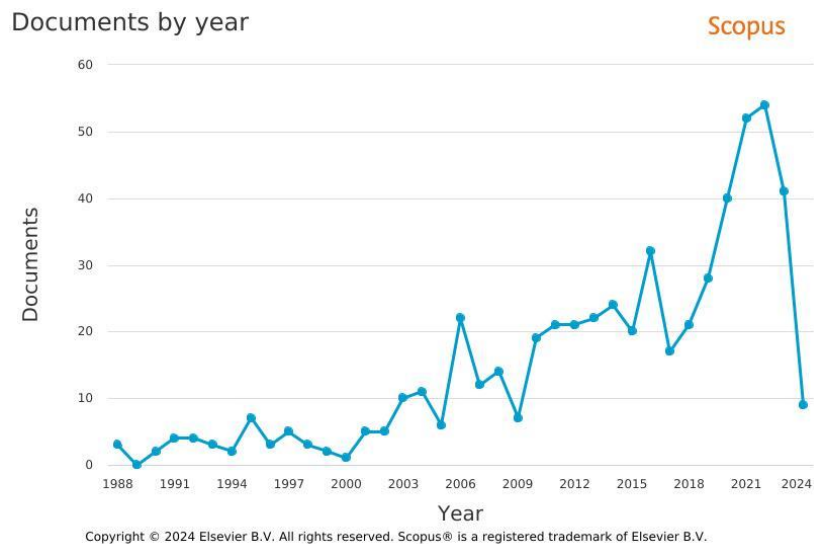


Figure 1. Publication Trends.

The bibliometric analysis shows a marked increase in publications addressing herbal treatments for male infertility from the late 1980s to 2024. The data highlights three main growth phases: an early period of limited publications (1980s–1990s), a moderate growth phase beginning in the early 2000s, and a peak period starting around 2020 with the highest publication rate noted in 2024. This sharp rise in recent years likely reflects the growing scientific and clinical interest in herbal medicine as an alternative or complement to conventional treatments for male infertility. Technological advancements in herbal bioactive compound isolation and increased research funding may have further contributed to this trend. These growth phases underscore the evolving recognition of herbal treatments as potentially effective therapeutic options within reproductive health.

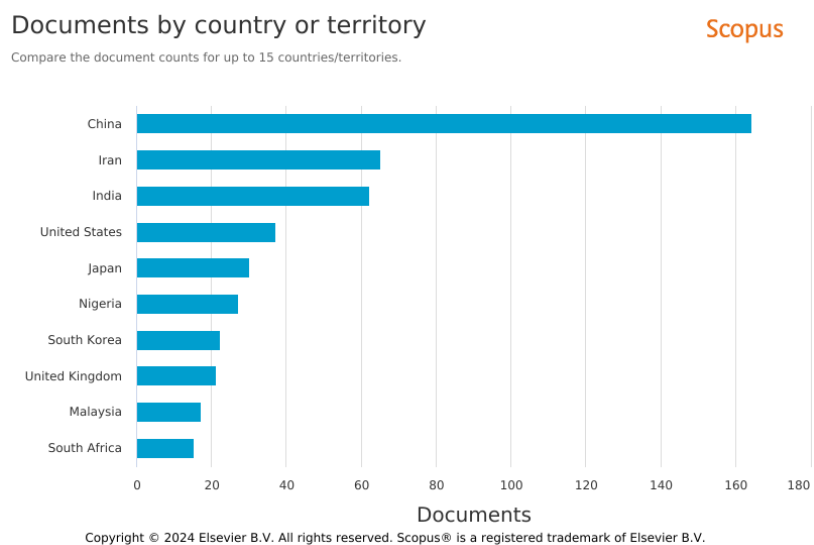


Figure 2. Geographical Distribution.

The analysis of geographical distribution reveals that China leads in research output on herbal treatments for male infertility, followed closely by Iran and India. This regional concentration reflects cultural, historical, and economic influences, particularly the longstanding traditions of Traditional Chinese Medicine (TCM) and

Ayurveda in these countries. Public interest and governmental support for traditional and alternative medicine in these regions may further explain the high output. However, this regional focus presents challenges for the global applicability of findings, especially in areas with limited representation in the dataset. Understanding the contextual factors that drive herbal research in Asia highlights the potential benefits and limitations of applying these findings universally.

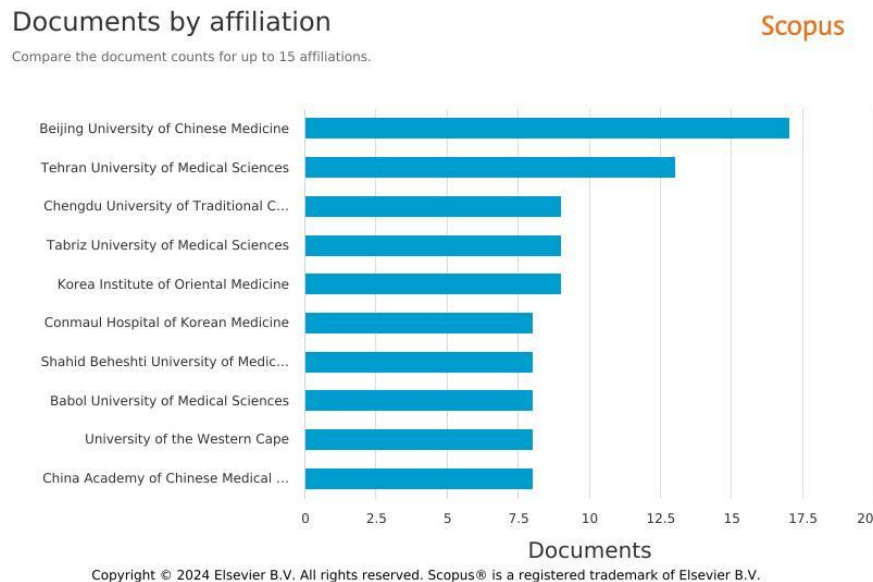


Figure 3. Institutional Contributions

The institutions most actively publishing in this area include Beijing University of Chinese Medicine and Tehran University of Medical Sciences, highlighting the role of academic institutions in driving research in herbal treatments. These institutions, along with others listed in the top contributors, are likely centers of excellence for herbal medicine research, possessing the necessary expertise and infrastructure to conduct rigorous scientific studies.

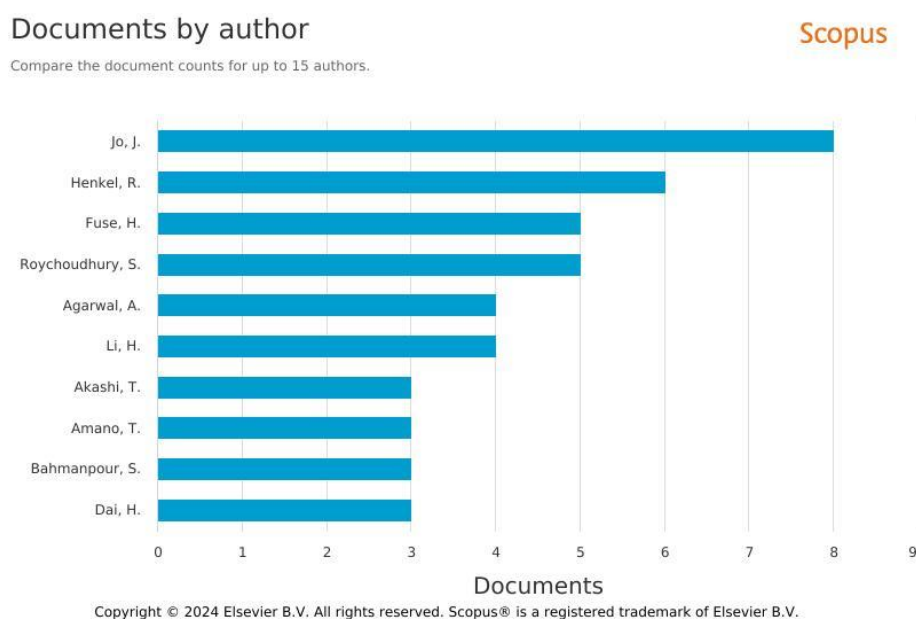
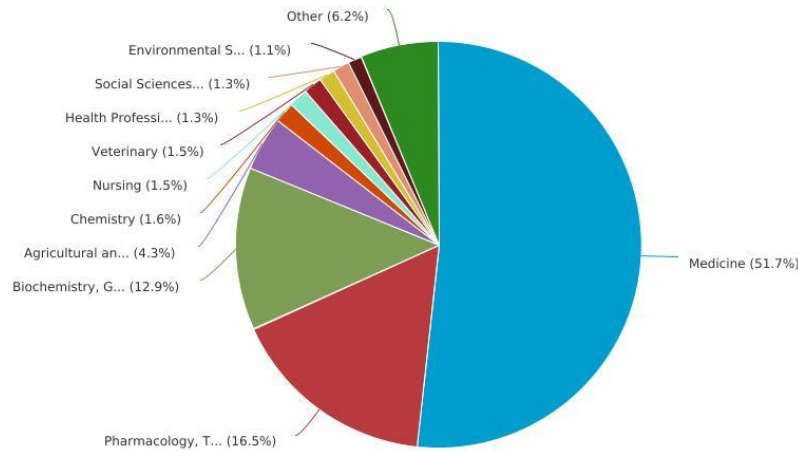


Figure 4. Key Authors and Collaborations.

The analysis identified several key authors who have multiple publications in the field, indicating a focused expertise in herbal treatments for male infertility. The networks formed by these authors, often spanning multiple institutions and countries, suggest a collaborative approach to research, which is crucial for advancing understanding in a multidisciplinary field like herbal medicine.

#### Documents by subject area

Scopus



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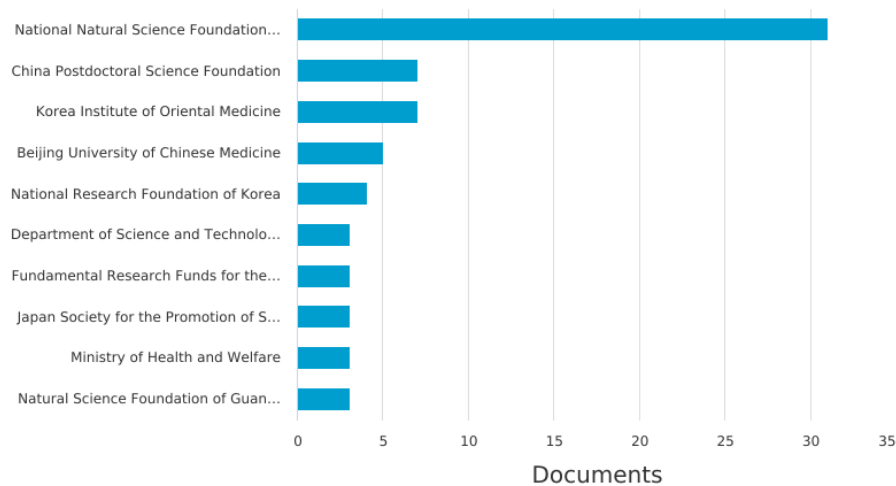
Figure 5. Key Authors and Collaborations.

The majority of the documents are journal articles, making up 76.3% of the publications, followed by reviews and book chapters. This indicates a strong research activity with peer-reviewed output that contributes to building a solid scientific foundation for herbal treatments in male infertility. Reviews constitute a significant portion, reflecting the ongoing need to synthesize existing research and identify new directions.

#### Documents by funding sponsor

Scopus

Compare the document counts for up to 15 funding sponsors.



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Figure 6. Funding and Research Support

The analysis of funding sources revealed that national scientific foundations, particularly in China and Korea, are the primary supporters of this research. This support underscores the importance placed by these countries on developing alternative and complementary medical treatments that align with their cultural and healthcare practices.

## Documents per year by source

Scopus

Compare the document counts for up to 10 sources. Compare sources and view CiteScore, SJR, and SNIP data



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Figure 7. Citation Impact

The data illustrates a discernible escalation in research publications beginning in the mid-2000s, with pronounced peaks around the years 2012, 2018, and notably in 2024. This trend likely reflects an expanding recognition of the potential benefits herbal treatments offer in managing male infertility, coupled with advancements in the field. Noteworthy is the sustained output of research articles in journals such as the Journal of Ethnopharmacology, which has consistently published significant research in this realm, culminating in a sharp peak in 2024. This journal, known for its focus on natural substances and traditional medicines, aligns closely with the thematic core of herbal treatments. Other significant contributors include the Evidence-Based Complementary and Alternative Medicine and the American Journal of Chinese Medicine, both of which have increasingly featured articles on alternative medical practices, especially in later years.

A regional analysis indicates a robust output from Chinese journals such as the Zhonghua Nan Ke Xue National Journal Of Andrology and the Chinese Journal of Integrated Traditional and Western Medicine, highlighting periodic shifts in research focus or funding within China. Additionally, the consistent presence of Andrologia, a globally recognized journal, underscores a sustained international interest in this field.

The implications of these trends are multifaceted. The sharp increase in publications, particularly in 2024, suggests a possible surge in novel research breakthroughs, increased financial backing, or heightened popularity of herbal remedies in treating male infertility. The prominence of research outputs from Chinese institutions not only underscores China's pivotal role in the study of traditional and herbal treatments—owing to its rich cultural heritage in traditional medicine—but also highlights the global relevance of this research field. The diversity of journals, encompassing various geographical regions and scientific disciplines, confirms the multidisciplinary and international appeal of herbal treatments for male infertility, attracting attention from both traditional medicine advocates and contemporary medical researchers.



#### Documents by subject area

Scopus

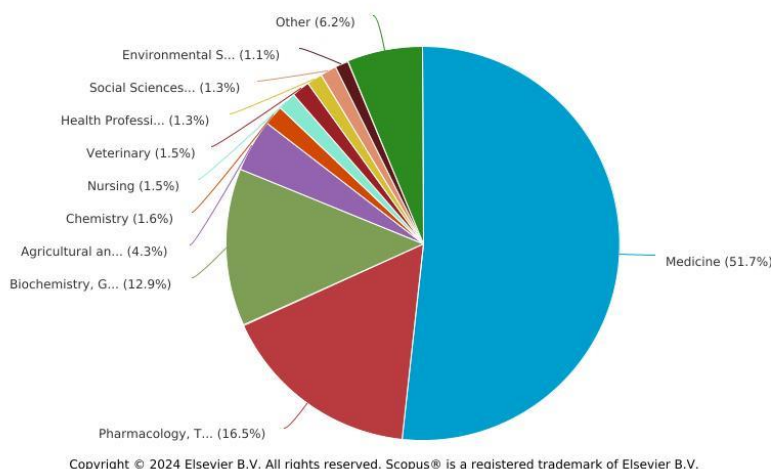


Figure 8. Thematical focuses

Subject area analysis shows that a significant portion of the research is classified under medicine, specifically in areas related to pharmacology, toxicology, and pharmaceuticals, and biochemistry, genetics, and molecular biology. This suggests a strong emphasis on understanding the physiological and biochemical mechanisms through which herbal treatments affect male fertility.

The bibliometric analysis presented provides a detailed overview of the state of research on herbal treatments for male infertility. It highlights the increasing interest and credibility these treatments are gaining within the scientific community. The geographical and institutional data point to the potential for expanding research collaborations globally, especially between Western and Eastern research centers, to foster a more diverse scientific exchange and explore the global applicability of findings.

Future research should aim to address the gaps in clinical trial data and standardization of herbal formulations to enhance the reliability of research outcomes. Additionally, exploring the integration of herbal treatments with conventional medical practices could provide a more holistic approach to managing male infertility, potentially improving patient outcomes and satisfaction.

## 4. Discussion

The growing body of research on herbal treatments for male infertility reflects a significant shift in how alternative medicine is perceived within the broader medical community. The consistent rise in publications, particularly the peak observed in 2024, suggests that herbal medicine is increasingly seen as a viable complementary approach to conventional infertility treatments. This shift likely stems from the limitations of conventional therapies, which often come with significant side effects and varying degrees of effectiveness. Herbal remedies, rooted in centuries-old traditions, offer a promising alternative that warrants further scientific exploration (Zegers-Hochschild et al., 2017).

One of the most critical aspects this analysis highlights is the geographical concentration of research, primarily in countries like China, Iran, and India. This concentration suggests that cultural and historical familiarity with herbal medicine plays a significant role in driving research. However, it also raises questions about the generalizability of these findings to populations outside these regions. Future research should aim to diversify the geographical scope of studies on herbal treatments for male infertility to understand better how these remedies perform in different cultural and biological contexts (Dhiman et al., 2011; Pan et al., 2014).

The role of traditional medicine systems such as Traditional Chinese Medicine (TCM) and Ayurveda is evident in the research output from these countries. These systems, with their holistic approaches, offer a different perspective on treating male infertility compared to Western medicine, which is often more reductionist. The integration of these traditional practices with modern scientific methodologies could pave the way for novel treatment approaches that are both effective and culturally sensitive. However, this integration requires careful

consideration of how traditional knowledge can be validated and adapted to meet contemporary scientific standards (Patwardhan et al., 2005; Wang et al., 2018).

A notable gap identified in the current research is the lack of rigorous clinical trials that adhere to the stringent standards of modern medicine. Many studies on herbal treatments are observational or based on small sample sizes, which limits the strength of the conclusions that can be drawn. There is a pressing need for well-designed, large-scale clinical trials that can provide robust evidence for the efficacy and safety of herbal treatments. Such trials should also consider potential interactions between herbal remedies and conventional medications, a concern that has not been adequately addressed in the literature (Ernst, 2000; Izzo et al., 2016).

Moreover, the standardization of herbal formulations remains a significant challenge. Unlike pharmaceutical drugs, which are synthesized to exact specifications, herbal remedies can vary widely in their composition depending on factors such as the source of the plant, the method of extraction, and storage conditions. This variability can lead to inconsistent therapeutic outcomes, which undermines the credibility of herbal medicine. Future research should focus on developing standardized formulations and ensuring quality control in the production of herbal remedies to enhance their reliability as treatment options (Bent, 2008; Williamson, 2001).

The bibliometric analysis reveals a diverse landscape of research on herbal treatments for male infertility, showing regional and methodological variations. Studies focused on Traditional Chinese Medicine (TCM) and Ayurveda, particularly from regions such as China, Iran, and India, have demonstrated that herbs like *Withania somnifera* and *Tribulus terrestris* positively impact sperm quality and hormonal regulation, aligning with traditional practices of these cultures (Wal et al., 2022; Wang et al., 2018). Comparatively, Western studies often emphasize the need for rigorous clinical trials and standardization of herbal formulations to meet modern pharmacological standards, highlighting concerns over dosage consistency and potential herb-drug interactions (Bent, 2008; Izzo et al., 2016). While TCM and Ayurvedic studies report broad positive outcomes, critics suggest these findings require further validation in larger, controlled trials to establish efficacy across diverse populations and integrate herbal treatments into mainstream medical practice (Ernst, 2000; Patwardhan et al., 2005).

The analysis also reveals that funding for research on herbal treatments is predominantly from national foundations in countries where traditional medicine is deeply ingrained in the culture. While this support is crucial for advancing the field, it also suggests a potential bias in research priorities. To achieve a more balanced and comprehensive understanding of herbal treatments, there needs to be greater international collaboration and funding from diverse sources. This would help mitigate the risk of regional biases and promote the development of globally applicable treatment protocols (Hesketh & Zhu, 1997; Tilburt & Kaptchuk, 2008).

Looking forward, the field of herbal medicine for male infertility is ripe for innovation. The application of modern technologies, such as nanotechnology, could enhance the delivery and efficacy of herbal compounds, making them more comparable to conventional pharmaceuticals in terms of effectiveness. Additionally, the exploration of novel herbal formulations, perhaps by combining different herbs or integrating them with conventional treatments, could lead to more effective and holistic approaches to managing male infertility.

In conclusion, while the current research provides a strong foundation, there is much work to be done to fully realize the potential of herbal treatments for male infertility. Future studies should prioritize rigorous clinical trials, standardization of formulations, and international collaboration to ensure that these treatments can be safely and effectively integrated into mainstream medical practice. By bridging traditional knowledge with modern science, the field has the potential to offer innovative solutions to one of the most challenging aspects of reproductive health (Patwardhan et al., 2005; Zegers-Hochschild et al., 2017).

## **5. Conclusion**

The bibliometric review of herbal treatments for male infertility encapsulates the evolving understanding and application of these natural therapies in addressing a pervasive health concern. Despite the historical and ongoing use of herbal medicine, documented increases in research outputs, particularly noted in 2024, underscore a significant shift toward recognizing and validating these treatments within scientific and medical communities globally. The robust contributions from countries like China, Iran, and India, where traditional medicine is ingrained in cultural practices, highlight a geographically diverse research base that both informs and expands current global healthcare options.



This surge in scholarly attention suggests an increasing reliance on and confidence in herbal remedies, supported by scientific exploration and institutional backing, particularly from centers of traditional medicine excellence. However, the review also points out the necessity for more rigorous scientific evaluations and standardized methodologies to ascertain the efficacy and safety of herbal interventions. By integrating modern scientific techniques with traditional knowledge, the field is poised to make substantial advances in treating male infertility, offering hope and new possibilities for affected individuals worldwide. This comprehensive analysis not only charts the progress in the field but also sets the stage for future research, emphasizing the need for continued exploration and validation of herbal remedies in clinical settings.

Ethics approval

Not required.

Competing interests

All the authors declare that there are no conflicts of interest.

Underlying data

Derived data supporting the findings of this study are available from the corresponding author on request.

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