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ALSTONIA SCHOLARIS: A BIBLIOMETRIC REVIEW

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Abstract— Alstoniascholaris *is a tropical medicinal plant species with significant pharmaceutical potential due to its diverse phytochemical constituents, particularly alkaloids, flavonoids, and other bioactive compounds. This study aims to evaluate the development and research direction of* A. scholaris *using a bibliometric approach. Data were obtained from the PubMed database covering the years 2015 to 2025, resulting in 79 publications analyzed using VOSviewer software. The analysis revealed a notable increase in publication trends, especially between 2020 and 2023, with a peak in 2021. Keyword visualization showed a strong focus on topics related to plant extracts, pharmacological activities, and indole alkaloids. Emerging topics such as ethnobotanical surveys and 16-epi-pleiocarpamine indicate a growing research interest in the application of natural bioactive compounds and molecular approaches. These findings suggest that* A. scholaris *not only holds broad therapeutic potential but also continues to attract scientific attention for further investigation in the context of modern natural product-based medicine.*

Keywords—Alstonia scholaris, bibliometric, medicinal plants, alkaloids, pharmacology

I. INTRODUCTION

Medicinal plants remain a vital source for the discovery of novel chemical compounds, despite the growing use of synthetic and combinatorial chemistry techniques by pharmaceutical companies in drug development. For centuries, nature has served as a primary source of therapeutic agents. Many modern pharmaceuticals have been derived from natural sources, often inspired by their traditional medicinal uses. A significant number of bioactive compounds have been successfully isolated from plants based on their ethnomedicinal applications[1]. Ethnobotanical knowledge, which reflects traditional practices of plant usage, has played a crucial role in the identification of medicinal species. One such plant with notable pharmacological potential is *Alstonia scholaris* (L.) R. Br., which contains a variety of active compounds in its leaves, stems, bark, and roots. These compounds have demonstrated potential in treating various health conditions, including cancer, digestive and respiratory disorders, and cardiovascular and reproductive issues[2].

Alstonia scholaris is a large tropical tree commonly found across Indonesia. It can grow up to 10–50 meters tall, with a straight trunk reaching a diameter of up to 60 cm. Its leaves are arranged in whorls of 4 to 9 per node, have pinnate venation, and display a glossy green surface. The bark is brittle, extremely bitter in taste, covered with lenticel-like dots, and has a thickness of 6–8 mm. When cut, the inner bark is white and exudes a milky latex[3]. *Alstonia* belongs to the Apocynaceae family, which comprises approximately 40–60 species distributed throughout tropical regions. These trees tend to thrive along moist riverbanks in evergreen rainforests. Several species, including *A. scholaris*, *A. boonei*, *A. cogenesis*, and *A. neriifolia*, are known and widely used as sources of traditional medicine due to their pharmacological properties such as anti-inflammatory, analgesic, antidiabetic, antimicrobial, and anticancer effects[2].

In this context, bibliometric analysis serves as a valuable tool for assessing the development, direction, and opportunities in research on *Alstonia scholaris*. This method applies quantitative and visual statistical techniques to evaluate scientific literature, allowing for the mapping of researcher collaboration, keyword trends, and thematic influences over time[4]. This study aims to analyze research trends related to *Alstonia scholaris* using a bibliometric approach. Overall, bibliographic analysis is essential for guiding researchers in identifying new perspectives, avoiding research redundancy, and optimizing resource allocation while also highlighting gaps that warrant further exploration.

II. MATERIALS AND METHODS

A. *Data Source*

The data used in this study were obtained from the PubMed database (https://pubmed.ncbi.nlm.nih.gov), managed by the National Center for Biotechnology Information (NCBI) in the United States. PubMed was chosen as the primary data source because it is a leading scientific database that provides broad and reliable access to literature in the fields of health and biotechnology. The search was conducted using the keyword *"Alstonia scholaris"*. The retrieved scientific publications were required to include this keyword, term, or phrase in the title, abstract, article content, or keywords. A total of 79 publications were identified, all of which were in English and published within the last ten years (2015–2025).

B. *Data Extraction and Analysis*

Data extraction and analysis were carried out by collecting relevant information from the identified scientific literature, including titles, abstracts, keywords, and full-text articles. After extraction, the data were analyzed to identify research trends and patterns. All retrieved articles were saved in "RIS" format and then imported into VOSviewer version 1.6.20 for bibliometric analysis. The analysis parameters included publication trends, contributing publisher analysis, keyword co-occurrence network, and overlay visualization.

C. *Term Map*

Bibliometric analysis has been widely applied by researchers across various scientific disciplines as an effective method to explore and interpret large-scale academic data. Numerous studies utilize this approach to map publication trends, research collaborations, and underexplored topics. This method relies on statistical tools to quantitatively and visually assess scientific literature, enabling the visualization of author collaboration networks, keyword trends, and topic influences over a defined period[4]. One of the primary tools used for bibliometric mapping is VOSviewer, a software designed to construct, visualize, and analyze bibliometric networks. VOSviewer can generate author or journal maps based on co-citation data, as well as keyword maps based on co-occurrence data[5]. By utilizing this software, researchers can identify both well-studied and under-researched areas within the literature. Keyword analysis with VOSviewer also provides valuable reference points for future research directions in less-explored domains.

III. RESULTS AND DISCUSSION

A. *Publication Trends*

The most recent research literature was retrieved from the PubMed database on June 8, 2025. A total of 79 publications related to *Alstonia scholaris* were identified over the past ten years, spanning from 2015 to June 2025. The publication trend, as illustrated in Figure 1, reveals fluctuations in the number of studies published each year.

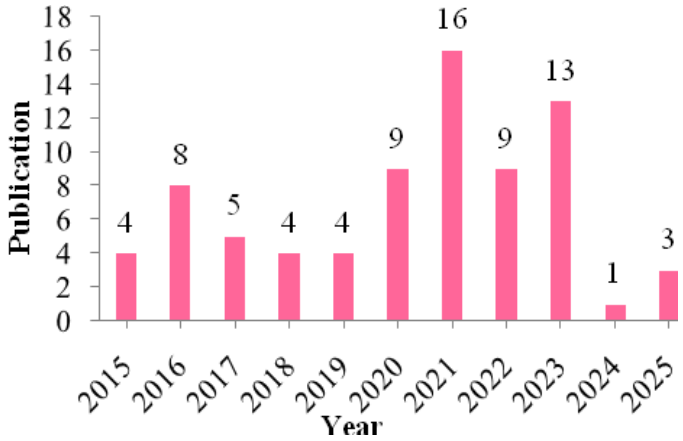


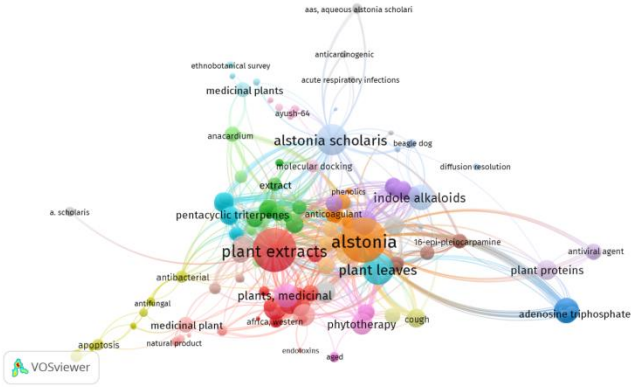
Fig.1. Publication trends

Between 2015 and 2019, the number of publications remained relatively low and stable, ranging from 4 to 8 articles per year, with an initial peak in 2016 at 8 publications. A significant increase began in 2020, reaching its highest point in 2021 with 16 publications—the most in the decade. The number of publications remained high in 2022 and 2023, with 9 and 13 articles respectively, indicating sustained interest in *A. scholaris* research. However, a sharp decline occurred in 2024, with only one publication recorded. As of May 2025, three publications had been noted, with the potential for further growth by the end of the year. This pattern suggests that interest in *Alstonia scholaris* research surged in the early 2020s, possibly driven by the global focus on natural remedies during the COVID-19 pandemic. Nevertheless, the decline in publications over the past two years warrants further investigation to determine whether it reflects a temporary fluctuation or a shift in research priorities.

B. *Keyword Visualization*

Based on the keyword co-occurrence network map (Figure 2) generated using VOSviewer software, thematic relationships among keywords related to *Alstonia scholaris* publications are illustrated. Frequently occurring keywords such as "alstonia," "plant extracts," "plant leaves," "indole alkaloids," and "medicinal plants" appear as central nodes with larger sizes, indicating their dominance in the literature. These keywords form interconnected clusters, reflecting research emphasis on phytochemical composition, bioactivity, and pharmacological applications of this plant. For instance, clusters containing keywords like "pentacyclic triterpenes", "anticoagulant", and "phenolics" indicate interest in the bioactive compounds found in *A. scholaris*. Other clusters with keywords such as "phytotherapy", "antibacterial", "antifungal", and "apoptosis" demonstrate a focus on biological activity and therapeutic potential. Additionally, the emergence of terms like "molecular docking", "plant proteins", and "adenosine triphosphate" suggests a growing trend toward molecular approaches in elucidating the mechanisms of plant-derived compounds. Overall, the visualization provides a comprehensive overview of current and emerging research directions on *A. scholaris*, particularly in identifying bioactive constituents, studying their biological effects, and utilizing bioinformatics in pharmacological studies.

Fig.2. Keyword co-occurrence network



Traditionally, *Alstonia scholaris* has long been used for medicinal purposes to treat various ailments. Different parts of *Alstonia* species have been employed in traditional medicine to address conditions such as malaria, asthma, dysentery, and gastric ulcers. The plant contains a wide array of pharmacologically active phytochemicals, including alkaloids, flavonoids, coumarin derivatives, leucoanthocyanins, reducing sugars, simple phenolics, steroids, saponins, and tannins. Among these, alkaloids are of particular interest due to their chemical diversity and significant pharmacological effects, making them a major target in drug discovery. Owing to its rich alkaloid content, *A. scholaris* has drawn substantial research attention as a potential source of therapeutic agents[2].

A large variety of alkaloids have been identified in *A. scholaris*, including echitamine, 17-O-acetyl echitamine, echitamine chloride, nareline, rhazine, vallesamine, scholaricine, scholarine, and picrinine, along with numerous picrinine-type and monoterpenoid indole alkaloids such as tubotaiwine, lagumamine (19-hydroxytubotaiwine), and pseudoakuammigine. Additional compounds include angustilobine B acid, losbanine, manilamine, dihydrocondylocarpine, alschomine, isoalschomine, mataranine A and B, and picralima-type alkaloids like picralinal. Other alkaloids such as corialstonidine and corialstonine have also been reported. The leaves contain further bioactive constituents such as quercetin, ursolic acid, alstonamine, alschomine, scholaricine, isorhamnetin, isorhamnetin-3-O-β-D-galactopyranoside, streptomycerol, β-sitosterol, akuammidine, angustilobine-B acid, losbanine, rhazimanine, and lagunamine. This chemical diversity reflects the broad pharmacological potential of *A. scholaris*, especially for natural product-based drug development[6]. Experimental studies have confirmed that *A. scholaris* exhibits various pharmacological activities including anticancer, antihypertensive, anti-inflammatory, analgesic, antidiabetic, nephroprotective, and neuroprotective effects, attributed to active phytochemicals such as alstonine, echitamine, picrinine, vallesamine, and scholaricine[2].

In a study byShanmugapriya et al., (2023), the methanolic leaf extract of *A. scholaris* was evaluated for its ability to induce apoptosis and generate reactive oxygen species (ROS) in breast cancer cell lines MCF-7 and MDA-MB-231. Bioactive constituents were isolated via column chromatography. DCFH-DA staining confirmed a significant increase in intracellular ROS levels, while apoptotic morphology was observed using acridine orange/ethidium bromide (AO/EtBr) dual staining. Cytotoxicity against MCF-7 cells was validated through the MTT assay. The extract also led to upregulation of the p53 gene, downregulation of BRCA1 and Bcl-2, and decreased concentrations of TNF-α and IFN-λ, supporting its anticancer potential through oxidative

stress induction and apoptosis-related gene regulation..Another study investigated the nephroprotective effects of dichloromethane extract of *A. scholaris* leaves in rats with gentamicin-induced nephrotoxicity. Treated rats showed significant improvement in renal biomarkers—serum levels of urea, creatinine, and uric acid were reduced, and total plasma protein levels were restored. Likewise, abnormal levels of urinary metabolites were corrected following extract administration, suggesting protective effects on renal function[8].

The bark extract of *A. scholaris* has also demonstrated therapeutic potential for diabetic nephropathy. In an experimental model, diabetic nephropathy was induced in rats using 65 mg/kg streptozotocin, followed by treatment with 300 mg/kg hydroalcoholic extract. Results showed significant reductions in blood urea nitrogen, albumin, creatinine, plasma proteins, urinary protein, and blood glucose levels. Additionally, treated rats exhibited increases in blood insulin, glycated hemoglobin, and renal antioxidant enzymes such as catalase, reduced glutathione, and superoxide dismutase. Histopathological evaluation revealed improved pancreatic and renal tissue architecture, indicating the extract's role in restoring glucose balance and mitigating oxidative stress in diabetic conditions[9]. In another in vitro study, the methanolic bark extract of *A. scholaris* was tested for antifungal activity against several fungal strains. Results showed inhibitory effects at low concentrations (2 mg) against *Saccharomyces cerevisiae*, *Candida albicans*, *Aspergillus flavus*, and *Aspergillus niger*, highlighting the extract's potential as a natural antifungal agent[10].

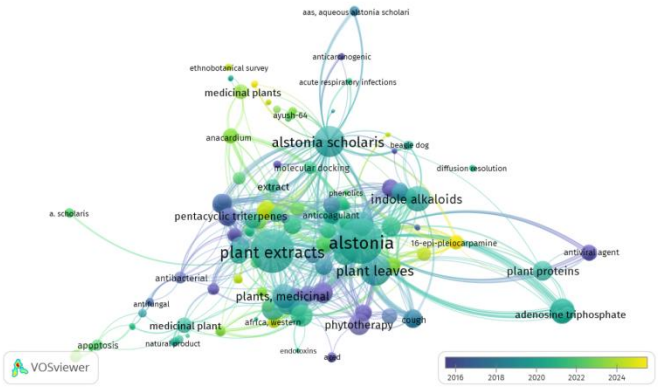


Fig.3. Keyword co-occurrence overlay with a time frame

According to the keyword overlay visualization (Figure 3), research trends demonstrate temporal evolution in *A. scholaris*-related topics. Each node color represents the average year of appearance in publications, ranging from purple (earlier research) to yellow-green (recent focus, 2023 onwards). Keywords such as "medicinal plants," "16-epi-pleiocarpamine," and "ethnobotanical survey" appear in yellowish tones, indicating that these topics are currently gaining traction. The emergence of terms like "ethnobotanical survey" and "medicinal plants" points to a renewed interest in traditional knowledge for drug discovery. Concurrently, the appearance of specific phytochemicals like 16-epi-pleiocarpamine reflects a growing research emphasis on isolating and investigating plant-derived therapeutic agents. These findings suggest that future research is likely to continue exploring natural bioactive compounds and traditional knowledge as foundational elements in modern herbal drug development.

IV. **CONCLUSION**

A bibliometric analysis of scientific publications on *Alstonia scholaris* over the past decade reveals a significant increase in interest regarding the plant's potential as a therapeutic agent. Keyword visualization and temporal trends indicate that research has evolved from traditional focuses such as extraction and basic biological activity to more advanced studies involving molecular modeling and the identification of specific compounds. The presence of alkaloids and other phytochemicals in *A. scholaris* has been associated with various pharmacological activities, including anticancer, nephroprotective, and antifungal effects. These findings highlight *A. scholaris* as a promising natural resource for drug development. Therefore, further comprehensive studies both in vitro, in vivo, and clinical are essential to validate and optimize the medicinal application of this plant.

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