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Review Article

Research on genus *Plumeria*: A gap finding bibliometric outlook

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ABSTRACT

For ages, the world has primarily depended on the rich diversity of flora and fauna for therapeutic lead molecules. Once such flora of biological importance is plants included in the genus *Plumeria*, as evidenced in Ayurveda, Charaka Samhita, and Sushruta Samhita. With this backdrop, the present review aims to scrutinize the work done between the time frame of 1999-2021 on the genus *Plumeria* based on bibliometric parameters by analyzing manuscripts indexed in one of the most popular databases, the Web of Science. The bibliometric review was carried out using VOSviewer software to demonstrate the research gap in this thematic area. In this, the various analyses carried out included co-occurrence analysis, citations analysis, and analysis of funding agencies. From the result, it could be seen that most researchers focused on the pharmacognostic/phytochemical evaluation of *Plumeria sp*. while at the same time leading to a shortage of research on their pharmacological and pharmaceutical aspects.

1. Introduction

Traditional medicinal plants or natural products are considered the best source for a new chemical entity (NEC) or lead molecule.[1] It is estimated that about 80% of those living in developing countries rely on traditional plant products for their healthcare needs.[2] This is so because medicinal plants have the upper hand over conventional therapeutic molecules in terms of their comparable efficacy (with conventional molecules), safety, and low cost.[3] Plants from the genus *Plumeria* represent one such traditionally used medicinal plant known for its ornamental excellence and fragrance.[4–8] Since research, at present, is primarily concerned with the development of newer therapeutics (thanks to COVID-19), the role of traditional medicinal plants in the search for novel lead molecules is in full swing.[9,10] Additionally, research nowadays is mostly interdisciplinary, which attracts countless challenges when scrutinizing its thematic composition. This demands detailed analysis, which, in turn, highlights the role of bibliometrics in visualizing the research gap in a pre-decided scientific domain.[11,12]

Having said this, it is interesting to note that researchers are increasingly using bibliographic data (from one or more databases) for future study designs.[13] However, one also needs to be aware of the limitations of such data sets, as seen when trying to narrow down a definition and delimitate a topic. Thus, it is crucial to establish a correlation between various published documents using bibliographic information in a particular database.

2. Review Methodology

Documents considered in this retrospective study were retrieved from the Web of Science database on 6th June 2021. The keyword '*Plumeria*' was used for searching

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the database. The authors initially intended to conduct a boolean (with AND) search with '*Plumeria*', 'stem cell', and 'cancer'. However, such a search returned no results, so the authors settled for the keyword *Plumeria*. Furthermore, all documents published between the time frame 1999-2021 were considered for evaluation. In all, 223 documents emerged as a result of the above-searched keyword. Manuscripts that were incorporated for analysis included articles (*n*=176), reviews (*n*=9), proceedings (*n*=12), meeting abstracts (*n*=11), editorials (*n*=7), news items (*n*=7), book chapters (*n*=1), book review (*n*=1) and early access (*n*=1). Next, data of all 255 documents were downloaded in '.txt' format. The bibliometric analysis was carried out using the software VOSviewer.

Additionally, methods used for the analysis of collected documents include:

2.1. Co-occurrence or keyword analysis

Initially, the data was fed into the software for keyword analysis, and 'co-occurrence' was chosen as the 'type of analysis'. Besides, 'all keywords' was selected as a 'unit of analysis'. Subsequently, the minimum 'number of co-occurrence of a keyword' was set to 2. In doing so, 197/1,202 keywords met the threshold. Then, based on the exclusion criteria, keywords were verified. This resulted in the selection of 76/197 keywords. The exclusion criteria for keywords included repeated/incomplete words, words with no sense with context to the present study, words beyond the scope of analysis of this review (i.e., names of plant species other than genus *Plumeria*), and words that had a first/a greater occurrence or link strength.

2.2. Other miscellaneous analyses

These were aimed to get more information regarding citations and funding agencies of published manuscripts. The above analysis was done using the 'Analyze Results' and the 'Create Citation Report' options in the top right corner of a particular search result page in the Web of Science database. After clicking on 'Analyze Results', the appropriate option (i.e., funding agencies) was selected for further analysis.

3. Results and Discussion

3.1. Co-occurrence analysis and the keyword map

Keyword co-occurrence analysis was conducted using VOSviewer, as shown in Figure 1.

Of the 76 keywords included in the study, 74 were connected. Words that stood as outliers were tobamovirus and polyphenol. This suggested that they had no relation to the genus *Plumeria*. Moreover, all interconnected terms were distributed across 9 clusters such as cluster 1 (13 items), cluster 2 (11 items), cluster 3 (11 items), cluster 4 (10 items), cluster 5 (8 items), cluster 6 (7 items), cluster 7 (6 items), cluster 8 (5 items), cluster 9 (3 items). Further, analysis of these clusters helped us identify the various species of *Plumeria* that had been researched. These included *Plumeriarubra* (cluster 8), *Plumeriaobtuse* (cluster 4), *Plumeriaacutifolia* (cluster 4), *Plumeriapudica* (cluster 1), *Plumeria acuminata* (cluster 5), *Plumeria alba* (cluster 3), *Plumeria bicolor* (cluster 6). A detailed analysis of these clusters is shown in Figure 2.

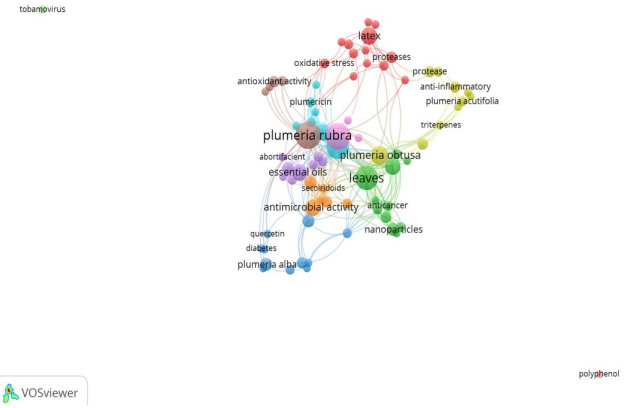

Figure 1: Keyword co-occurrence analysis by VOSviewer

Results showed that researchers primarily worked on identifying the phytoconstituents of various plant species. Consequently, the biological activity obtained from these plant extracts/their phytoconstituents was explored, as evidenced by the data obtained from figure and as documented in Table 1 .

3.2. Other miscellaneous analysis

3.2.1. Citation analysis

Detailed citation analysis is depicted in Figure 3. The h-index was 21, whereas the average citation per item was 9.29. Moreover, articles were cited around 1,826 times (88%, excluding self-citation) from 1999-2021. This also shows that authors self-cited their articles only by a very marginal amount of 12%. Also, citation rates peaked at around 2020, which could be due to researchers trying to find new lead molecules for the treatment of COVID-19 or its associated comorbidities (i.e., cancer and diabetes).[14,15]

3.2.2. Analysis of funding agencies involved

Top 3 funding agencies which financed *Plumeria* research included the Conselho Nacional de Desenvolvimento Cientifico e Tecnologico (CNPq) (7.623%), the Fundação Cearense de Apoio ao Desenvolvimento Científico e Tecnológico (FUNCAP) (4.036%) and the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) (3.139%). Figure 4 shows the document count of the top

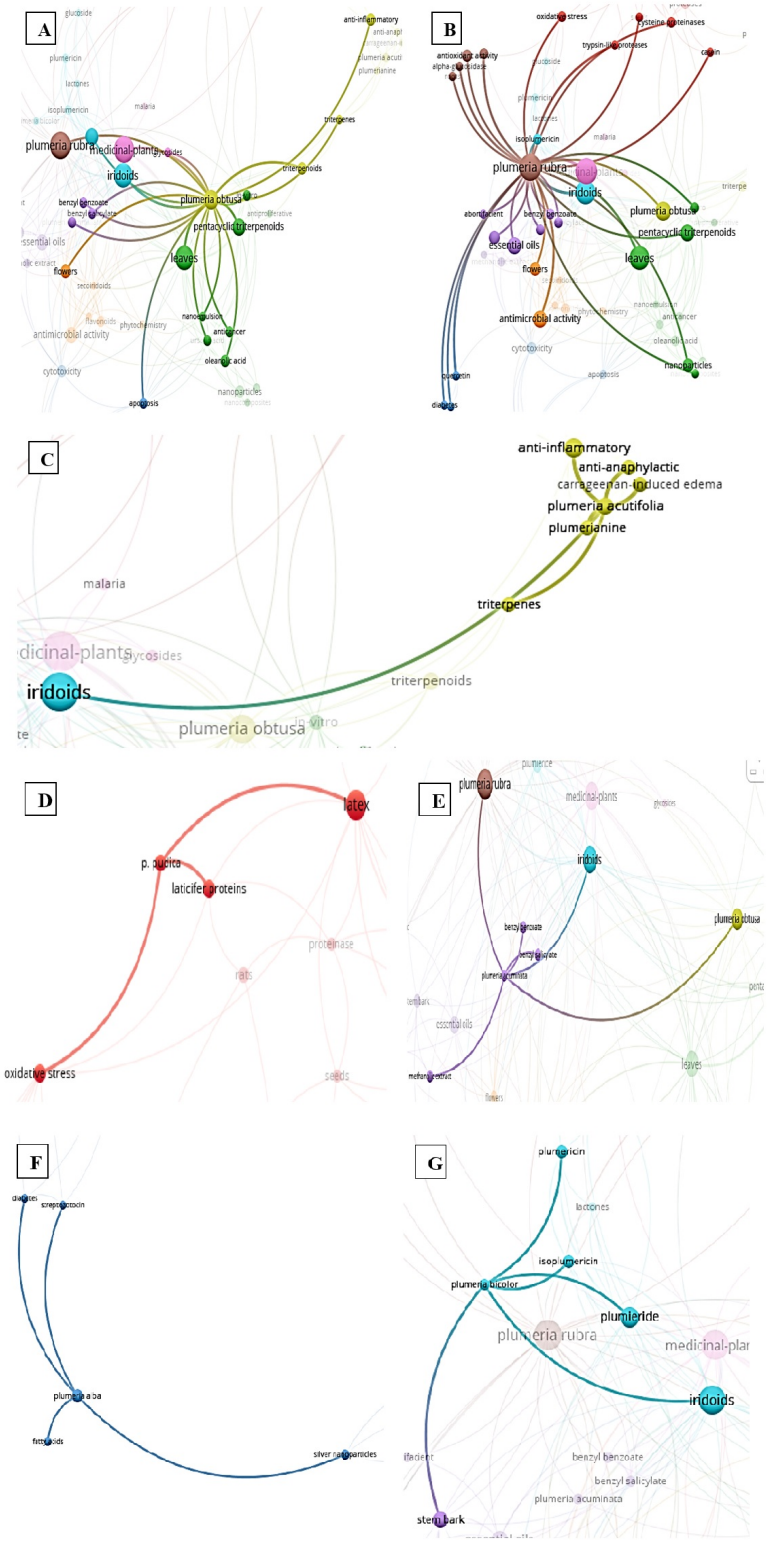

Figure 2: Detailed co-occurrence analysis (A) *Plumeria obtusa*; (B) *Plumeria rubra*; (C) *Plumeria acutifolia*; (D) *Plumeria pudica*; (E) *Plumeria acuminata*; (F) *Plumeria alba*; (G) *Plumeria bicolor*

Table 1: Overview of research done on various plant species

Plant species (Plant parts used)	Phytoconstituents identified	Biological activity explored	Formulations derived
Plumeria obtuse (Flowers and leaves)	Iridoids, Benzyl benzoate, Benzyl salicylate, Pentacyclic triterpenoids, Triterpenoids, Triterpenes, Oleanolic acid, Ursolic acid, Glycosides, Plumieride	Anti-inflammatory, Anticancer, and Apoptosis	Nanoemulsion
Plumeria rubra (Flowers, leaves, roots, and stem barks)	Alpha-glucosidase, Pentacyclic triterpenoids, Iridoids, Essential oils, Benzyl benzoate, Benzyl salicylate, Quercetin, Streptozotocin, Isoplumericin, Trypsin-like proteases, Cysteine proteinases	Anti-microbial activity, Abortifacient, Oxidative stress, Diabetes	Nanoparticle, Nanocomposite
Plumeria acutifolia (Flowers, leaves, roots, stem barks)	Iridoids, Plumerianine, Triterpenes	Anti-inflammatory, Anti-anaphylactic, Carrageenan-induced edema	(N/A)
Plumeria pudica (N/A)	Laticifer proteins, Latex	Oxidative stress	(N/A)
Plumeria acuminate (N/A)	Iridoids, Benzyl benzoate, Benzyl salicylate	(N/A)	(N/A)
Plumeria alba (N/A)	Fatty acids, Streptozotocin	Diabetes	Silver nanoparticles
Plumeria bicolor (Stem bark)	Plumericin, Isoplumericin, Plumieride, Iridoids	(N/A)	(N/A)

Note: N/A - Not available (Research gaps with future research potential)

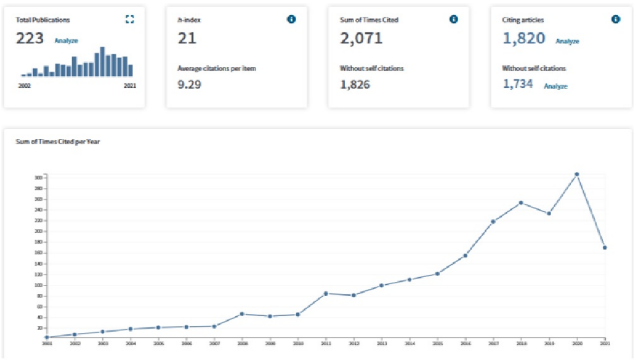

Figure 3: Detailed citation analysis

25 funding agencies across the globe.

Figure 4: Top 25 funding agencies involved in *Plumeria* research

4. Conclusion

Analysis of the role of funding sources and the critical research gaps are the most vital areas in research for a research scholar. Results revealed that although much work had been done in the phytochemical screening of various species of *Plumeria*, there still remains a research gap as far as biological activity and the development of viable pharmaceutical formulations were concerned. One such possible gap is that the nephroprotective (and hepatoprotective) activity of genus *Plumeria*, which has not been explored despite the fact that this genus has been proven to be quite useful in treating diabetes (diabetic nephropathy is a common problem in diabetes). Therefore, scholars can work in this direction and many such gaps, as mentioned by N/A in Table 1. Consequently, this would help fulfill the grey areas of research in this thematic arena (as evident by the h-index and funding agencies involved in financing the study) and further impact our current knowledge of medicinal plants to develop better therapeutics for the future.

5. Source of Funding

None.

6. Conflict of Interest

None.

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