RESEARCH ARTICLE

Bibliographic analysis of *Clinacanthus nutans* papers in Scopus database (2000–2019) [version 1; peer review: 1 not approved]

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**Abstract**

**Background:** There has been an increasing trend in *Clinacanthus nutans*’ research, an important medicinal herb of Malaysia and Thailand, well known as an anti-viral, anti-cancer, and insect bite treatment. This study examines the trend in *Clinacanthus nutans*’ research from 2000 to 2019 and compares the contribution of research on this topic from different institutions and authors.

**Methods:** Publications from the Scopus database were retrieved using keywords and identify top ten institutions/universities, list of prominent authors, top ten journals that published research, top five influential articles, top fifty cited papers, and global distribution of publications on *Clinacanthus nutans*. Microsoft Excel 2016, Wordcloud, SPSS version 26, and GunnMap 2 were used to analyse indicators. A total of 167 articles were identified from the Scopus database. All research publications were screened initially. Five articles (n=5) were removed due to the unavailability of the full-text version of the article. 162 articles were included in the final study.

**Results:** Universiti Putra Malaysia and the Journal of Ethnopharmacology published the highest number of articles on *Clinacanthus nutans*. Herpes, antioxidant, phenolic, flavonoids, cancer, antimicrobial were common keywords identified using a word cloud. Over the past 20 years, the literature on *Clinacanthus nutans* has continuously grown, with the rate increasing after 2012.

**Conclusion:** The prominent research on *Clinacanthus nutans* was based upon their identified and isolated bioactive constituents, and there is a need for more research on clinical trials.

**Keywords**

Clinacanthus nutans; Bibliographic analysis; Scopus
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**Abbreviations**

CRO: Clinical Research Organisations
NKEA: National Key Economic Areas Research Grant Scheme
FRGS: Fundamental Research Grant Scheme
NRGS: Niche Research Grant Scheme
RAGS: Research Acculturation Grant Scheme
FRIM: Forest Research Institute of Malaysia
MIS: Malaysian International Scholarship
NSFC: National Natural Scientific Foundation of China
NAFOSTED: Vietnam National Foundation for Science and Technology Development
TCM: Traditional Chinese Medicine

**Background**

Medicinal plants are a source of natural, semi-synthetic, or synthetic analogues with pharmacological potential and development of new therapeutic leads. Their potentially curative properties' chemical source is the secondary metabolites of medicinal plants. Traditional Chinese medicine (TCM) remedies have been used in China for centuries and often remain “different” from present Western medicine (WM), as they are still now primarily herbal mixtures. There is an increasing trend in identifying and isolating bioactive compounds in the poly-mixture of TCM. For example, pericarpium citri reticulatae (Rutaceae), commonly called chen pi in Chinese, as a regulating qi drug, is most frequently used in several Chinese medicine prescriptions.

*Clinacanthus nutans* (Burm. f) Lindau (Acanthaceae) is indigenous to Southeast Asia. It is commonly known as *Belalai Gajah* (Malay) and *Phaya Yo* (Thai). *Clinacanthus nutans* used in different therapies, such as for skin rashes, snake bites, lesions caused by herpes simplex virus, diabetic myelitis, and fever. It is a good source of many flavonoids and phenolics. Several in vivo and in vitro pharmacological activities have reported. The most promising activities consist of anti-inflammatory, antioxidant, anti-tumour, anti-viral and antibacterial activities.

Bibliometric analyses have used previously to study the measures of quality and impact of research performed in pharmacovigilance, bioactive chemical constituents, and health-related issues such as burns, pressure ulcer, mesothelioma, colorectal cancer. It has also used to understand the impact of an important research topic. For example, Nano-medicine is one of the emerging issues in the treatment of cancer, and a bibliometric analysis was performed to understand the global trends in this field. The selection of the current topic is based upon the medicinal importance of *Clinacanthus nutans* in South East Asia.

Many research articles (i.e., phytochemical, pre-clinical, in-vitro studies) published recently on *Clinacanthus nutans* were funded by the Ministry of Education Malaysia (MOE) under the National Key Economic Areas Research Grant Scheme (NKEA), the Fundamental Research Grant Scheme (FRGS), the Niche Research Grant Scheme (NRGS), and the Research Acculturation Grant Scheme (RAGS). The research funded by universities' internal grants, the natural Products Division, Forest Research Institute of Malaysia (FRIM). The student in Malaysia is also encouraged to study this medicinal herb under MyBRAIN and Malaysian International Scholarship (MIS). The study on the selected plant funded by other countries such as National Natural Scientific Foundation of China (NSFC), Vietnam National Foundation for Science and Technology Development (NAFOSTED), National Research Council Thailand, Thailand Research Fund and Higher Education Commission Thailand.

This study investigated trends in *Clinacanthus nutans* research in recent years using the Scopus database. The researcher analysed publication outcomes from the last 20 years (2000–2019). This first attempt to use bibliographic to analyse *Clinacanthus nutans*-related publications aims to understand better global trends in research of one of the most well-known medicinal herb of Southeast Asia.

**Methods**

**Data source and search strategy**

*Clinacanthus nutans* was used as a keyword to search inside the Scopus database. The data collection strictly follows the Scopus database and relevant articles indexed during the given time. Other databases, such as PubMed or Web of Science, are not part of the current study. In this study, the search terms were as follows: TITLE-ABS-KEY (clinacanthus AND nutans) AND PUBYEAR > 1999 AND PUBYEAR < 2020. A flow diagram of selected articles on *Clinacanthus nutans* is shown in Figure 1.
Information extraction
The data were downloaded from the Scopus database and imported manually into Microsoft Excel 2016 (RRID: SCR_016137); Google Sheets (RRID:SCR_017679) is an open access alternative. KYJ and QLC verified the data entry and collection. The entered data consist of articles, the first author, co-authors, h-index of the first and corresponding author from Scopus. The number of Scopus citation of selected articles were part of data collection. Other data consist of the name of journal/conference, journal ranking according to Scopus (CiteScore), date of publication according to the journal website, year of paper according to Scopus, data of submission of an article, date of acceptance, number of universities/organisation contributed to that publication, name of universities/organisation contributed to that publication, journal impact factor (CiteScore) taken from Scopus, type of article, most vital topic/category, subject area, keywords, list of the significant issue addressed, number of countries, location of authors, number of pages, number of references, number of figures, number of tables, an affiliation of the corresponding author, the association of the first author, funding and department/institution/faculty.

Statistical analysis
IBM SPSS Statistics 26 (RRID:SCR_019096; JASP (RRID:SCR_015823) is an open source alternative) and Microsoft Office Excel 2016 (Microsoft Corporation, Santa Rosa, California, USA) was used to analyse the characteristics of the publications. Wordclouds.com (Zygomatic, Netherlands) has been used to create a cloud of keywords. GunnMap 2 was used to create a custom world map to depict the distribution of global publications on Clinacanthus nutans.

Results
Universiti Putra Malaysia contained the maximum number of record (n = 38), followed by University Sains Malaysia (n = 18). Table 1 shows the top 10 institutions/universities that published their research on Clinacanthus nutans.

Khatib, A., from the International Islamic University Malaysia was found to be the most prominent researcher to contribute to Clinacanthus nutans (n = 11). Abas, F., was the top female researcher that contributes from Universiti Putra Malaysia, Serdang, Malaysia, on Clinacanthus nutans (n = 10). A list of the most prominent authors in studying Clinacanthus nutans is shown in Table 2.

The Journal of Ethnopharmacology (ISSN 0378-8741) has published the highest number of records on Clinacanthus nutans (n = 9), whereas BMC Complementary and Alternative Medicine (ISSN 1472-6882) were second to published
**Table 1. The top 10 institutions/universities published research on Clinacanthus nutans.**

| Name                              | Country        | Global QS Ranking (2020) | Number of Records |
|-----------------------------------|----------------|--------------------------|-------------------|
| Universiti Putra Malaysia         | Malaysia       | #159                     | 38                |
| Universiti Sains Malaysia         | Malaysia       | #165                     | 18                |
| International Islamic University Malaysia | Malaysia   | #651-700                 | 15                |
| Universiti Teknologi MARA         | Malaysia       | #651-700                 | 12                |
| Universiti Malaysia Sabah         | Malaysia       | #801-1000                | 10                |
| Universiti Kebangsaan Malaysia    | Malaysia       | #160                     | 9                 |
| Universiti Teknologi Malaysia     | Malaysia       | #217                     | 8                 |
| Mahidol University                | Thailand       | #314                     | 8                 |
| National University of Singapore  | Singapore      | #11                      | 5                 |
| Khon Kaen University              | Thailand       | #801-1000                | 5                 |

**Table 2. List of most prominent authors in studying on Clinacanthus nutans.**

| Name             | Gender | Number of Records | Institution/Universities                                                   | h-index (Scopus, 2019) | i10-index (Scholar google) |
|------------------|--------|-------------------|---------------------------------------------------------------------------|------------------------|---------------------------|
| Khatib, A.       | Male   | 11                | International Islamic University Malaysia, Kuala Lumpur, Malaysia          | 23                     | 53                        |
| Abas, F.         | Female | 10                | Universiti Putra Malaysia, Serdang, Malaysia                              | 28                     | 114                       |
| Zakaria, Z.A.    | Male   | 8                 | Universiti Putra Malaysia, Serdang, Malaysia                              | 31                     | 108                       |
| Shaari, K.       | Female | 8                 | Universiti Putra Malaysia, Serdang, Malaysia                              | 26                     | 78                        |
| Ismail, M.       | Female | 6                 | Universiti Putra Malaysia, Serdang, Malaysia                              | 25                     | 110                       |
| Khoo, L.W.       | Female | 5                 | Universiti Putra Malaysia, Serdang, Malaysia                              | 3                      | N/A                       |
| Tham, C.L.       | Female | 5                 | Universiti Putra Malaysia, Serdang, Malaysia                              | 11                     | 13                        |
| Abdullah Sani, N.| Female | 5                 | Universiti Kebangsaan Malaysia, Bangi, Malaysia                           | 13                     | 23                        |

**Table 3. The top 10 journals to published on Clinacanthus nutans.**

| Rank | Journal                                      | Number of Records | ISSN               | CiteScore 2018 |
|------|----------------------------------------------|-------------------|--------------------|----------------|
| 1    | Journal of Ethnopharmacology                 | 9                 | 0378-8741          | 3.68           |
| 2    | BMC Complementary and Alternative Medicine   | 8                 | 1472-6882          | 2.69           |
| 3    | Molecules                                    | 6                 | 1420-3049          | 3.28           |
| 4    | AIP Conference Proceedings                   | 5                 | 0094-243X          | 0.37           |
| 5    | Evidence-based Complementary and Alternative Medicine | 4             | 1741-427X          | 2.01           |
| 6    | Acta Horticulture                            | 4                 | 0567-7572          | 0.25           |
| 7    | Tropical Journal of Pharmaceutical Research  | 3                 | 1596-5996          | 0.54           |
| 8    | Asian Pacific Journal of Tropical Biomedicine| 2                 | 2221-1691          | 2.03           |
| 9    | Asian Pacific Journal of Tropical Medicine   | 2                 | 1995-7645          | 1.87           |
| 10   | Pharmaceutical Biology                       | 2                 | 1388-0209          | 2.43           |
(n = 8). The CiteScore (2018) of the *Journal of Ethnopharmacology* (3.68) was also highest among the other competing journals on this medicinal plant. Table 3 shows the top 10 journals publishing research on *Clinacanthus nutans*.

The authorship heat map shows some interesting facts. The number of authors has increased with time. There were few authors one of a paper in the initial years, but with time, the number of authors has increased to more than seven. This could be due to an increase in research on these medicinal herbs and increasing cross-collaboration among different institutions due to the rise in funding availability and utilisation of various resources from different universities (Figure 2).

The top influential articles published on *Clinacanthus nutans* are based upon bioactive constituents,\(^ {30,31}\) anti-inflammatory property,\(^ {29}\) anti-cancer, and antioxidant potential of the plant\(^ {12}\) (Table 4).

**Figure 2.** Authorship heat map of *Clinacanthus nutans* research 2000–2019.

**Table 4.** Top five influential articles on *Clinacanthus nutans* published during the period 2000–2019.

| First and corresponding author with year | Article Title                                                                 | Journal                                      | Total Citation | Reference |
|-----------------------------------------|------------------------------------------------------------------------------|----------------------------------------------|----------------|-----------|
| Sakdarat, S., et al., 2009               | Bioactive constituents from the leaves of *Clinacanthus nutans* Lindau        | Bioorganic and Medicinal Chemistry           | 81             | 30        |
| Wanikiat, P., et al., 2008               | The anti-inflammatory effects and the inhibition of neutrophil responsiveness by *Barleria lupulina* and *Clinacanthus nutans* extracts | Journal of Ethnopharmacology                 | 71             | 29        |
| Yong, Y.K., et al., 2013                 | *Clinacanthus nutans* extracts are antioxidant with antiproliferative effect on cultured human cancer cell lines | Evidence-based Complementary and Alternative Medicine | 69             | 32        |
| Tuntiwachwuttikul, P., et al., 2004      | Cerebrosides and a monoacylmonogalactosylglycerol from *Clinacanthus nutans* | Chemical and Pharmaceutical Bulletin        | 50             | 31        |
| Pannangpetch, P., et al., 2007           | Antioxidant activity and protective effect against oxidative hemolysis of *Clinacanthus nutans* (Burm.f) Lindau | Songklanakarin Journal of Science and Technology | 42             | 39        |
Analysis of the keywords of articles published between 2000 and 2019 identified some significant interests, such as “anti-inflammatory”, “anti-cancer”, “antioxidants”, “antibacterial”, “flavonoids”, “phenolic”, “apoptosis”, and “traditional medicine”. Figure 3 illustrates the word cloud developed from the website.

The top fifty most cited papers, as of February 27, 2020, on _Clinacanthus nutans_ were identified and are shown in Table 5.

There is an increasing trend in the number of the published article since 2012. There was a high number of citations and a low number of articles published in 2005. This year is considered the period of initiation of research on these medicinal plants. Bioactive compounds were identified, giving a pathway to carry out further study (Figure 4).

Malaysia was ranked as number one in producing papers on _Clinacanthus nutans_, followed by Thailand and then China. Figure 5 illustrates the global distribution of publication on _Clinacanthus nutans_.

**Discussion**

_Clinacanthus nutans_ is one of the highly researched medicinal plants in recent years in Malaysia and Thailand. The bibliographic analysis helps to show the past trends on related topics, current research progress to identify the top researcher, institutions, and help find similar funding. Several articles published on bibliographic analysis in health-related fields. There is limited literature available on the bibliographic analysis of medicinal plants. The research identifies many phytochemical and pre-clinical studies on _Clinacanthus nutans_. Current research is more focused on
Table 5. List of top 50 cited papers on *Clinacanthus nutans*.

| Rank | First author name       | No of Citations | Rank | First author name       | No of Citations |
|------|-------------------------|-----------------|------|-------------------------|-----------------|
| 1    | Chomnawang, M.T.        | 173             | 26   | Lusia Barek, M.         | 75              |
| 2    | Mahady, G.B.            | 94              | 27   | Huang, D.               | 76              |
| 3    | Chomnawang, M.T.        | 88              | 28   | Chelyn, J.L.            | 77              |
| 4    | Sakdarat, S.            | 81              | 29   | Aslam, M.S.             | 6               |
| 5    | Uawonggul, N.           | 72              | 30   | Wong, F.-C.             | 78              |
| 6    | Wanikiat, P.            | 71              | 31   | Liew, S.-Y.             | 79              |
| 7    | Yong, Y.K.              | 69              | 32   | Shim, S.Y.              | 80              |
| 8    | Ching, S.M.             | 51              | 33   | Abdul Rahim, M.H.       | 41              |
| 9    | Tuntiwachwuttikul, P.   | 50              | 34   | Saokaew, S.             | 43              |
| 10   | Alam, A.                | 49              | 35   | Yang, H.S.              | 45              |
| 11   | Cheeptham, N.           | 42              | 36   | Mustapa, A.N.           | 46              |
| 12   | Pannangpetch, P.        | 42              | 37   | Vachirayontien, T.      | 48              |
| 13   | Arullappan, S.          | 42              | 38   | Chomnawang, M.T.        | 49              |
| 14   | Mustapa, A.N.           | 40              | 39   | Thongrakard, V.         | 50              |
| 15   | Janwitayanuchit, W.     | 39              | 40   | Zulkipli, I.N.          | 5               |
| 16   | Siew, Y.-Y.             | 36              | 41   | Tsai, H.-D.             | 52              |
| 17   | Ghasemzadeh, A.         | 33              | 42   | Teoh, P.L.              | 54              |
| 18   | Chotchoungchatchai, S.  | 32              | 43   | Ch’ng, Y.S.             | 56              |
| 19   | Tu, S.-F.               | 29              | 44   | Raya, K.B.              | 57              |
| 20   | Kongkaew, C.            | 28              | 45   | Sarega, N.              | 59              |
| 21   | Kunsorn, P.             | 28              | 46   | Pongmuangmul, S.        | 61              |
| 22   | Mustapa, A.N.           | 28              | 47   | Le, C.-F.               | 63              |
| 23   | Khoo, L.W.              | 28              | 48   | Fazil, F.N.M.           | 65              |
| 24   | Mai, C.W.               | 25              | 49   | Radhakrishnan, N.       | 67              |
| 25   | Huang, D.               | 23              | 50   | Yahaya, R.              | 69              |

Figure 4. Correlation between yearly output, number of citation and number of published articles.
toxicity studies before preparing for clinical trials to evaluate its health benefits on humans. Although there is an increasing trend in pre-clinical studies on Clinacanthus nutans, there is a lack of protocols or research to conduct the clinical trial. The only available registered clinical trial when search through clinicaltrials.gov had the title “prevention of mucositis in patients with head and neck cancer treated with radiotherapy”, which completed in March 2018. The research also identified an increasing trend in research collaboration in recent years, which could be a positive direction for developing a new drug analogue or a multi-herb combination.

Conclusion
Clinacanthus nutans is one of the future potentially important herbs of Southeast Asia. Malaysia and Thailand were the most significant contributors to studies on the medicinal properties or therapeutic potential. Clinical research organisations could increase research collaboration with academia to reduce the literary gap, provide financial support, especially during a pandemic such as COVID-19; fasten the process of clinical trial and growing commercialisation of medicinal herbs, especially for herbal economies such as Malaysia and Thailand.

Ethics declarations
This study was secondary analysis based on previous published studies. Ethics approval and consent to participate is not applicable.

Consent for publication
Not applicable.

Data availability
Underlying data
All data underlying the results are available as part of the article and no additional source data are required.

Contributors
All authors participated in the study conception and design. MSA performed the bibliographic analysis. KYJ and QLC interpreted the data, drafted and critically revised the manuscript and approved the final version to be published. All authors had full access to all the data and took responsibility for the data integrity and data analysis accuracy.

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This paper seems to have the interest to cover a bibliometric analysis of the *Clinacanthus nutans* over the past 20 years. However, while it has presented a few bibliometric indicators, this paper doesn't have a clear direction and objectives. I would suggest the aims of this paper and the research questions clearly being defined in the background section. The authors did specify that they want to analyze the trend but it seems too general.

I'm not sure if the problem statement is clearly being defined i.e. the reason why this bibliometric analysis is important to be conducted. The literature review on the subject matters also seems not convincing.

Why the results of the fundings are presented in the background section?

**Methods**

- I'm not sure mentioning the author names in order to do the data entry and verification is proper in this academic paper.

- Based on this statement: "The entered data consist of articles, the first author, co-authors, h-index of the first and corresponding author from Scopus." - I'm not sure the data entry still required as most of the data downloaded from Scopus were already completed. I'm not sure if the h-index of the first and corresponding author from Scopus is necessary to be collected while it not being presented in the results. The result presented is just about the top author (in which they can be not just the first or corresponding author). I don't think the h-index of the authors is necessary as well. The h-index of the publications probably more meaningful.

- These statements seem quite confusing: "journal ranking according to Scopus (CiteScore)" and "journal impact factor (CiteScore)" - I think the definition of CiteScore has been misinterpreted here.
- Some of the data collected and mentioned in the information extraction section seem not even been analyzed. So, what for? Some also seem not practical such as the location of authors (?), the association of the first author (?), most vital topic/category (?).

- Not sure why IBM SPSS Statistics 26 has been used since there is no complicated statistic has been presented in this paper.

**Results**

- All the results presented are too descriptive. There are no further interpretations or elaborations that worth as part of the contribution of this paper. The so-what question has not properly addressed for each of the results.

- Would be good if the analysis can be extended in order to analyze the impact of the paper based on the number of citations and h-index on the publications.

- Figure 4 looks quite confusing. What is the difference between yearly output and the number of published articles?

- There is no legend for Figure 5. Not sure what the colours are representing.

**Discussion**

- I am not sure how the results of this paper can really "help find similar funding".

- "Several articles published on bibliographic analysis in health-related fields" - this is the health-related topic, of course, it will be published in this related journal.

- The contribution of this paper seems not convincing enough to justify the indexing of this paper.

**Conclusions**

- Not sure if the conclusion is really derived from the findings.

- How about the limitations of the study and future research?

**Is the work clearly and accurately presented and does it cite the current literature?**

Yes

**Is the study design appropriate and is the work technically sound?**

No

**Are sufficient details of methods and analysis provided to allow replication by others?**

Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**

No

**Are all the source data underlying the results available to ensure full reproducibility?**

Yes

**Are the conclusions drawn adequately supported by the results?**
No

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Bibliometric analysis

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

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