



EXPLORING THE ANTICANCER POTENTIAL OF *Loranthus* SPECIES: A BIBLIOMETRIC ANALYSIS

M. H. G. R. Deshan^{*} and B. D. Madurapperuma

Department of Botany, The Open University of Sri Lanka, Sri Lanka

Loranthus species, known as mistletoes, are gaining unprecedented attention as anticancer species. This review aims to explore and evaluate the anticancer potential of *Loranthus* species by examining their traditional Ayurvedic uses, and phytochemical composition. The methodology involved a comprehensive literature review using academic databases such as Google Scholar (32 articles), Academia (24 articles), ResearchGate (18 articles), Web of Science (45 articles), and PubMed (34 articles), employing relevant search terms to collect data. VOS Viewer software was used to analyse the information, elaborate on the analysis, such as trend line, keywords, types of articles and phytochemicals. A structured questionnaire survey was conducted with ten Ayurvedic practitioners to gather insights on the clinical use of *Loranthus* species. The number of publications related to mistletoe cancer treatment has shown a marked increase since the early 1990s, peaking at 38 articles in 2023, indicating growing scientific interest in this field over the past three decades. The network visualisation highlights Mistletoe's role in cancer treatment, focusing on clinical applications, molecular mechanisms, and biochemical properties, while also emphasising its integration in Ayurvedic and traditional medicine. This review, supported by a survey of Ayurvedic practitioners in Sri Lanka, highlights the anticancer potential of *Loranthus* species. Traditional use confirms their value, particularly with host-specific variations noted for medicinal effectiveness. Phytochemical analysis reveals key bioactive compounds—flavonoids, polyphenols, terpenoids, and lectins—with strong antioxidant and anticancer properties. Extracts of *L. micranthus*, *L. europaeus*, and *Dendrophthoe falcata* show cytotoxic effects against breast, lung, cervical, ovarian, and colon cancer cells through apoptosis induction and immune modulation involving NF-κB and JAK/STAT pathways. Survey feedback stresses the need for standardization due to host-related variability and a lack of clinical trials, despite strong preclinical evidence. These findings support further research into *Loranthus* as a natural anticancer agent within the Ayurvedic framework.

Keywords: *Loranthus*, mistletoe, anticancer, ayurvedic, literature, visualisation

^{*}Corresponding Author: s19007618@ousl.lk



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Department of Botany, The Open University of Sri Lanka, Sri Lanka

INTRODUCTION

Cancer is one of the major diseases affecting people globally. It is the second leading cause of mortality worldwide contributing to poor quality of life after cardiovascular diseases (Mahjour *et al.*, 2018). There is no definitive cure for cancer. However, several rationally devised cancer treatments have been introduced over the last few centuries. The natural product continues to be important as a source of novel drugs because they are cost-effective, less toxic, require minimal sophisticated instruments, and typically do not encounter bacterial resistance, unlike synthetic drugs (Arman *et al.*, 2013). Traditional uses of *Loranthus* plants suggest that they may contain bioactive compounds with potential anticancer effects (Wiart, 2007). Preliminary research indicates that extracts from *Loranthus* species exhibit cytotoxicity against cancer cells and may possess mechanisms that inhibit tumour growth or induce the death of cancer cells. In this review, the anticancer activity of *Loranthus* species is discussed.

This study aims to explore the existing literature to support the anticancer potential of *Loranthus* species by reviewing its traditional Ayurvedic uses, identifying key phytochemicals, and examining its therapeutic properties, to provide a comprehensive understanding of its role in cancer therapy.

The objectives of this review are to conduct a bibliometric analysis to predict trends in *Loranthus*-related cancer treatment research, explore its potential therapeutic applications, and evaluate the growing interest in *Loranthus* species in traditional medicine, with a focus on their phytochemical properties.

METHODOLOGY

The literature review was conducted using a methodology intended to collect reliable information through an integrated approach. Bibliographic data were collected using specific queries exported as full records with cited references. Relevant search terms combined with Boolean operations ensured focused, high-quality articles from the databases (Snyder, 2019).

TS=(“anticancer activity” OR “anti-cancer activity” OR “anti-tumour activity” OR “anti-neoplastic activity” OR “cancer inhibition” OR “cancer treatment”) AND TS=(‘*Loranthus*’ OR “*Loranthus* species” OR “*Loranthus* plant” OR “*Loranthus* extract” OR ‘mistletoe’ OR “mistletoe species”)



TS=('cancer' OR 'tumour' OR 'neoplasia' OR 'malignancy') AND TS=('Loranthus' OR 'mistletoe') AND TS=('bioactivity' OR 'phytochemical' OR 'pharmacological' OR 'cytotoxic' OR 'therapeutic' OR 'medicinal' OR 'antiproliferative')

Data sources included academic databases like Google Scholar (32 articles), Academia (24 articles), ResearchGate (18 articles), Web of Science (45 articles), and PubMed (34 articles).

Additionally, the data was collected through Ayurvedic books such as Charaka Sanhithawa, Suskrutha Sanhithawa, Ayurveda Aushada Sangrahaya, indigenous medicinal databases, and library visits. There is a knowledge gap regarding the clinical practices of Ayurvedic uses of *Loranthus* spp. due to unpublished knowledge. To address this gap, a structured questionnaire survey was conducted with ten Ayurvedic practitioners to gather personal communication information about the clinical aspects and practical applications of *Loranthus* species in traditional medicine. To better understand the research on the anticancer potential of *Loranthus* species, a bibliometric analysis was conducted. VOSviewer software, a popular tool for visualising bibliometric networks, was used for the above purpose. The data was obtained by downloading bibliographic records directly from scientific databases like Scopus and Web of Science in formats that are compatible with VOSviewer, such as .csv or .txt files. This helped ensure consistency in metadata, including author names, journal titles, and keywords.

RESULTS AND DISCUSSION

Bibliometric data analysis

The line graph (Fig. 1) shows the trend of Mistletoecancer treatment-related research, from 1952 to 2024. During the early years, from the 1950s until the late 1970s, publication was low, and fewer than five articles were published annually. The rate of publication increased substantially from the mid-1990s, with peaks in the early 2000s and continuously high figures sustained throughout the 2010s, reflecting ongoing research activity over this time. The most prominent peak, at around 36 articles, was seen in the early 2020s, reflecting a recent upsurge in interest, perhaps resulting from developments in cancer research and integrative medicine.

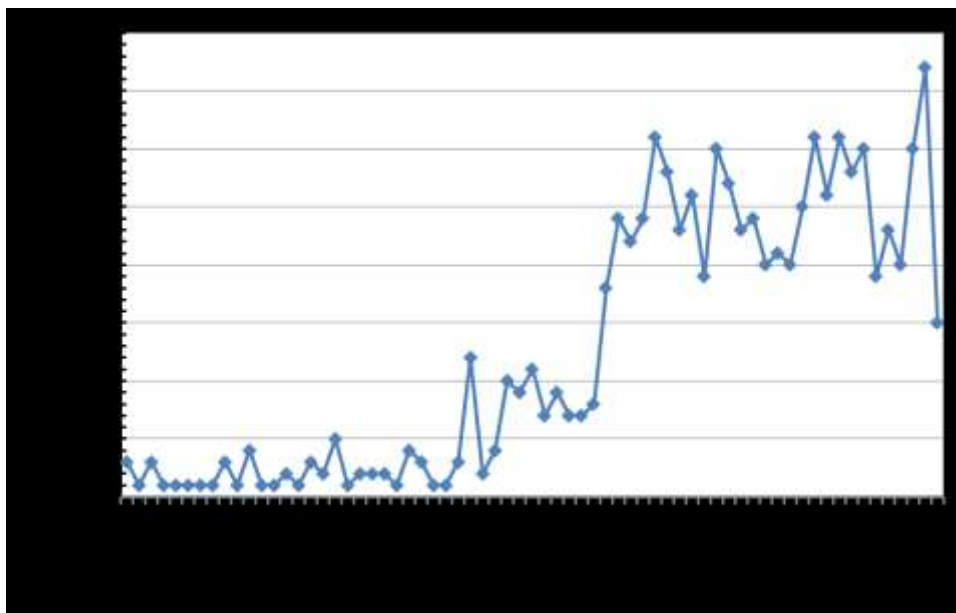


Figure 1. *Mistletoe Cancer Treatment-Related Papers (1952-2025).*

VOS-viewer data analysis

The VOS-viewer bibliometric map (Fig. 2) below indicates the most significant terms in the context of Mistletoe and anticancer research between 2000 and 2015. Nodes are words extracted from the literature, with each node's size being directly proportional to how many times a word was cited. The bigger nodes such as cell, activity, apoptosis, cancer cell, plant, and cancer patient represent core research areas such as cellular response, apoptotic processes, and patient-related parameters. Dark blue (2000) to yellow (2015) color gradient indicates the trend of term application over time and shows that in the beginning, the majority of early studies primarily studied cellular-level activities such as lymphocyte modulation, expression, and binding, while in recent years more attention was focused on clinical endpoints such as quality of life (QoL), oncology, adjuvant treatment, and alternative medicine. The map also displays dense interconnections between basic biological research and clinical oncology with a note on the range of Mistletoe research extension from basic cell investigations to therapeutic applications aimed at patients. The vast number of interlinkages reflects the multidisciplinary nature of Mistletoe cancer research, linking Botany, Molecular Biology and Clinical Medicine.

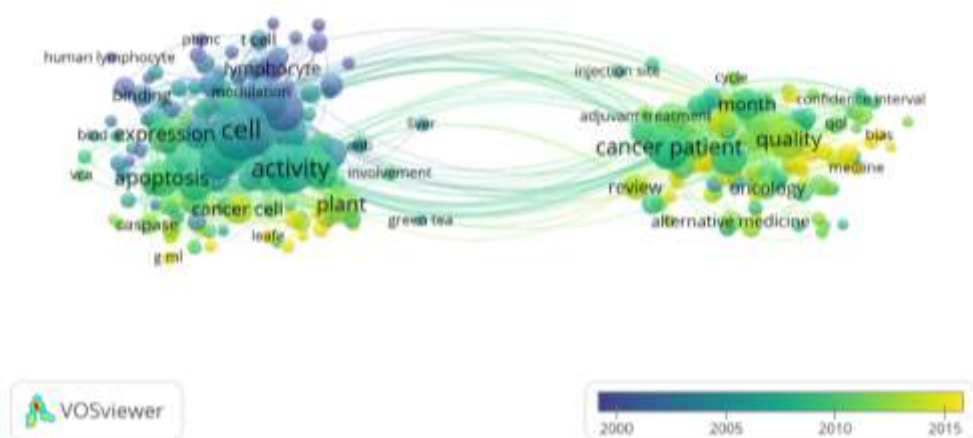
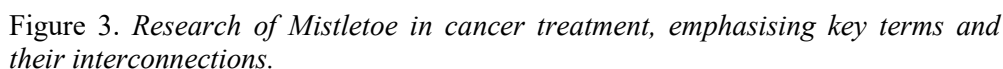


Figure 2. Key word analysis of reviewed articles using PubMed data.

This network visualisation (Fig. 3) provided by VOS viewer extensively shows the research of Mistletoe in cancer treatment, emphasising key terms and their interconnections. Three clusters are represented on the map: clinical applications (red), molecular mechanisms (green), and biochemical properties (blue). Aspects of patient-centred clinical studies like therapy, side effects, survival, and alternative medicine are included in the red cluster regarding Mistletoe extracts. The green cluster emphasises cellular responses to Mistletoe lectins in cancer inhibition, with a focus on apoptosis, proliferation, and immune modulation. The blue one relates to structural and biochemical work involving the terms lectin, binding, viscumin, and monoclonal antibody, suggesting a focus on the molecular characterisation of active compounds. Integration between these clusters indicates a strong research strength bridging the biochemical properties of Mistletoe with its anticancer mechanisms and clinical implications. In the keyword co-occurrence network created with VOSviewer, the largest node represented lectin. This shows that lectin is the most studied and discussed compound group related to *Loranthus* species and anticancer activity. The prominence of lectin as a node indicates that it frequently appears in titles, abstracts, and keyword lists. This suggests it is a main focus of *Loranthus*-related anticancer research.



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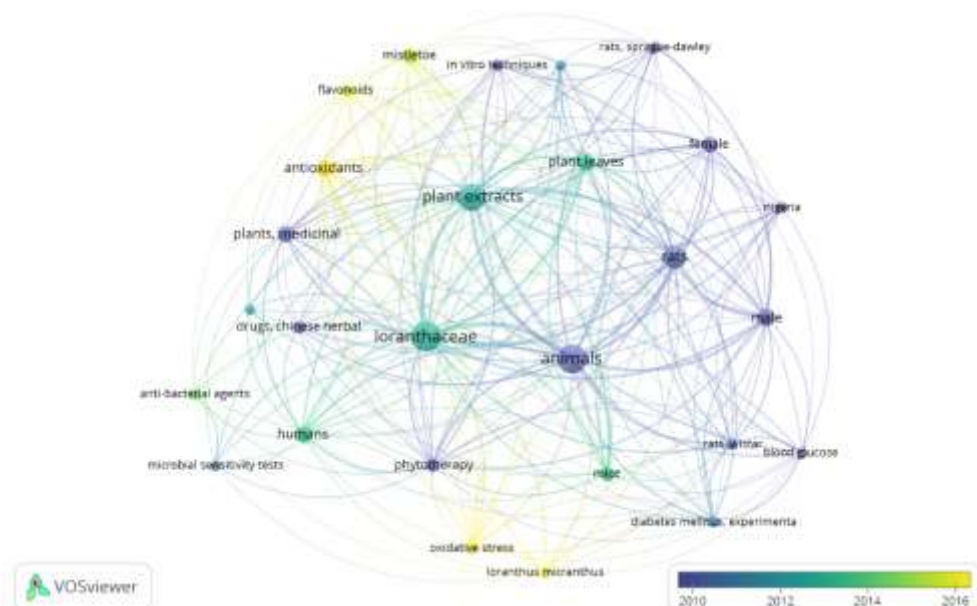


Figure 4 Articles related to Ayurvedic uses of *Loranthus* species.

Survey data analysis

Based on the collected data, *Loranthus* species are predominantly utilised in Hela Wedakama rather than in Ayurvedic medicine. In traditional medicinal practices, *Loranthus* is commonly used for cancer treatment as well as WishaWedakama (toxicology treatments). Notably, these plants are not used in isolation but are incorporated into formulations such as decoctions and pastes, combined with other medicinal plants. In Hela Wedakama, *Loranthus* species are identified based on their host plants (Kuramana *et al.*, 2020; Barlow, 1983; Mutiah *et al.*, 2018; Muhammad *et al.*, 2019). For cancer treatments, practitioners primarily use *Loranthus* species parasitising *Aegle marmelos* (bael tree), *Syzygium aromaticum* (clove tree), *Mangifera indica* (mango tree), and *Cymbopogon* spp. (citronella). This highlights the importance of host-plant relationships in traditional medicine, as the host species influences the medicinal properties of *Loranthus*.

CONCLUSIONS/RECOMMENDATIONS

Evaluating the anticancer potential of *Loranthus* species indicates their importance in modern and traditional medicinal systems. This review provides evidence increasingly supporting the use of these parasitic plants as anticancer agents. Ethnomedicinal data confirmed the usage of different *Loranthus* species across traditional medical systems, such as Ayurveda, and indigenous healing practices.



Medicinal properties are recognized only for some specific host-dependent groups, increasing the need to develop research on different species along with their host trees, according to Ayurvedic practitioners in Sri Lanka and India. Phytochemical analysis indicates the richness of secondary metabolites such as flavonoids (quercetin, kaempferol), polyphenols, terpenoids, and lectins with *Loranthus* species. Most of these bioactive compounds found in these species possess potent antioxidant activity that might be useful in cancer prevention and treatment by eliminating oxidative stress-induced carcinogenesis. Among these, flavonoids and lectins are most promising in experimental studies for their aptitude in inducing apoptosis and inhibiting tumour progression. There is still much more to be done in spite of these promising findings. Bioactive composition is variable as a result of associations of different host plants, geographic distribution, and environmental phenomena, and this calls for standardisation of extraction and dosage. Clinical trials in human populations are scant, while preclinical studies show much anticancer promise. Such experiments should be conducted in a controlled environment to scientifically validate the effectiveness, safety, and probable side effects of formulations based on *Loranthus*.

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