

Digital Profiling of Wound-Healing Plants in Malay Medical Manuscripts: Philological and Ethnobotanical Analysis for the Development of an Integrated Taxonomic Model

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ABSTRACT

Malay medical texts like Kitab Tib safeguard a wealth of traditional pharmacological knowledge detailing diverse concoctions of indigenous flora for the treatment of wounds and ailments. Nevertheless, this wisdom is confined to archaic manuscripts and oral traditions that are at risk of vanishing due to a lack of formal heirs and the disparity between conventional terminology and contemporary scientific categorisation. In light of the worldwide challenge of antibiotic resistance and the escalating costs of chronic wound management, the systematic conversion of this legacy into scientific paradigms has become increasingly imperative. This concept document outlines a three-phase transdisciplinary research approach that combines philological examination of manuscripts, anthropological fieldwork with traditional medical practitioners and Orang Asli communities, and the creation of a digital ontology model. This paper illustrates the utilisation of the "Wound Ethnobotanical Cross-Translation Table" via a pilot study on *Chromolaena odorata* (pokok kapal terbang), correlating traditional medical expressions like "stop bleeding" and "dry the wound" with contemporary pathophysiological processes such as haemostasis and epithelialization. Initial results suggest notable congruence between indigenous knowledge and current scientific data, thereby affirming the methodological dependability of application across the full range of documented wound-healing botanical species. This document outlines the empirical study's progression through three stages, culminating in the creation of a prototype interactive digital database, "e-Luka Perubatan Tradisional Melayu" (Malay Traditional Wound Medicine). The suggested framework possesses strategic promise as a catalyst for advancing traditional Malay medicine into scholarly discussion and contemporary health science, in accordance with Dewan Bahasa dan Pustaka's goals to enhance the Malay scientific lexicon and safeguard manuscripts as vital data resources.

Keywords: Malay medical manuscripts, ethnobotany, ontology model, wound care, digital profiling

INTRODUCTION

The contemporary world is confronted with two interrelated global health emergencies: the increasing incidence of metabolic disorders resulting in chronic wounds (like diabetic foot ulcers) and the peril of antimicrobial resistance (AMR) undermining the effectiveness of current antibiotics (Nazir et al., 2025; Coque et al., 2023). In this scenario, communities are progressively reverting to their traditional medical legacies to discover novel bioactive compounds and more comprehensive, economical treatment methods

(Abdallah, 2024). The achievements of China, exemplified by Ben Cao Gang Mu's production of artemisinin for malaria therapy (Wang et al., 2019), and India's Traditional Knowledge Digital Library (TKDL) in safeguarding traditional intellectual property rights (Fredriksson, 2022), demonstrate that the methodical conversion of traditional knowledge can yield worldwide influence.

Malaysia, recognized as a mega-biodiverse nation, enjoys distinct benefits from its biological diversity, as well as from its extensive collection of traditional Malay medicinal texts that encompass empirical information on the use of indigenous flora (Ramya et al., 2024). Manuscripts like Kitab Tib serve not just as literary artefacts but also as historical pharmacopoeias cataloguing diverse botanical remedies for addressing "venomous injuries," "lacerations," "fractures," and "thermal injuries" (Yusoff & Daud, 2023; Harun, 2015). Nonetheless, this wisdom is confined within archaic manuscripts and oral traditions that are at risk of disappearing. Numerous traditional Malay medical practitioners are advanced in age, and many have died without leaving sufficient written records, resulting in the loss of excellent wound treatment formulations (Aziz et al., 2023).

Most Malay medical practitioners' knowledge is preserved in handwritten manuscripts, now facing physical deterioration due to environmental factors and age (Che Hassan et al., 2023). The difficulty in understanding old Jawi script and classical medical terminology has created a knowledge gap between older and modern generations. Without systematic documentation, this heritage will remain rigid archival material with no practical application (Ding, 2014). Additionally, a critical gap exists between the traditional nomenclature used in manuscripts (e.g., "wound-covering leaf") and modern scientific classification. This gap arises from dialectal variations, the lack of visual documentation, and differences in the interpretation of Jawi text. Without a systematic integration system, this valuable data cannot be utilized by biomedical researchers, policymakers, or health practitioners (Fauzi et al., 2025).

This concept document seeks to address these gaps by introducing a transdisciplinary research framework comprising three primary phases. This paper specifically intends to: (1) systematically identify, characterize, and record wound and injury treatment plant formulations from selected manuscripts, correlating traditional terminology with contemporary pathophysiological mechanisms; (2) create a "Malay Wound Care Ontology Model" that amalgamates ethnobotanical information, phytochemical characteristics, and Linnaean classification within a digital context; and (3) advocate for the establishment of a prototype database, "e-Luka Perubatan Tradisional Melayu," serving as a cross-referential resource for researchers, healthcare professionals, and policymakers.

LITERATURE REVIEW

Malay Medical Manuscripts: A Threatened Heritage of Knowledge

Malay Traditional Medicine (MTM) encompasses more than just the application of natural substances; it embodies a philosophical framework that integrates physical, spiritual, and environmental components (Zakaria & Zainal, 2017). Hadi and Harun (2022) assert that Malay medical manuscripts like Kitab Tib reveal that the historical Malay community possessed an extensive comprehension of anatomy and physiology associated with the equilibrium of four elements (fire, water, air, and earth). This ideology underscores that healing transcends symptom management, focusing instead on re-establishing equilibrium between humanity and nature for comprehensive wellness.

In the realm of wound management, the literature (kitab-kitab Tib) frequently links healing to notions of "venom," "inflammation," "heat," and "contamination," necessitating herbal remedies that are cooling, purifying, or desiccating (Ahmad, 2002). Initial investigations conducted by Harun Mat Piah (2006) indicate that Malay medical literature reflects anatomical and physiological knowledge consistent with several tenets of Greco-Arabic medicine. Aziz et al. (2023) caution that the decline of traditional healers is leading to a rapid erosion of knowledge regarding medicinal flora. Harun (2015) asserts that Malay medical writings have thousands of formulas that remain untranslated into contemporary scientific terminology.

A distinctive conceptual facet of MTM frequently disregarded in traditional medicine is the notion of compatibility. MTM underscores that not every medication is appropriate for all individuals, even if they share the same condition. This doctrine asserts that pharmaceuticals should align with the patient's constitution and the temporal and spatial context of therapy (Aziz et al., 2023). This approach exemplifies a primitive iteration of personalised medicine, where the choice of herbs is influenced by the patient's biological characteristics and knowledge of natural rhythms. The concept of MTM includes principles of environmental sustainability ethics; traditional herb gatherers are instructed on certain guidelines, such as refraining from uprooting entire plants or obtaining consent before collection. Pranata et al. (2025) contend that documenting these techniques in digital formats is essential to ensure that future commercial use of herbs adheres to the ecological limits set by Malay forebears.

Epistemological Gaps and Knowledge Fragmentation

The extensive application of wound-healing botanical traditions in contemporary healthcare texts is hindered by numerous significant deficiencies. Initially, gaps in nomenclature. Terminology found in Jawi texts, like "venomous wound," "dirty blood," and "cooling medicine," does not have direct counterparts in contemporary biomedical language, such as bacterial infection, tissue necrosis, or analgesics. The plethora of regional designations for identical species (e.g., pokok kapal terbang, pokok jepun, busuk-busuk, panca alam for *Chromolaena odorata*) frequently hinders the mapping of interdisciplinary literature globally.

Secondly, data fragmentation. Crucial insights into the medicinal properties of wound-healing flora are currently scattered across multiple fields: ethnographic documentation, untranslated ancient texts, and contemporary pharmacological studies. The lack of a cohesive database linking different areas of knowledge hampers the translation of community experiential insights into scientifically validated findings. Thirdly, the obliteration of oral information. Numerous Malay medical practitioners and traditional midwives have no heirs, resulting in the loss of their herbal medicine knowledge upon their demise. Aziz et al. (2023) underscore that, in the absence of formal heirs, efficient wound-care formulations dissipate alongside them.

The Importance of Digital Profiling and Ontology Modelling

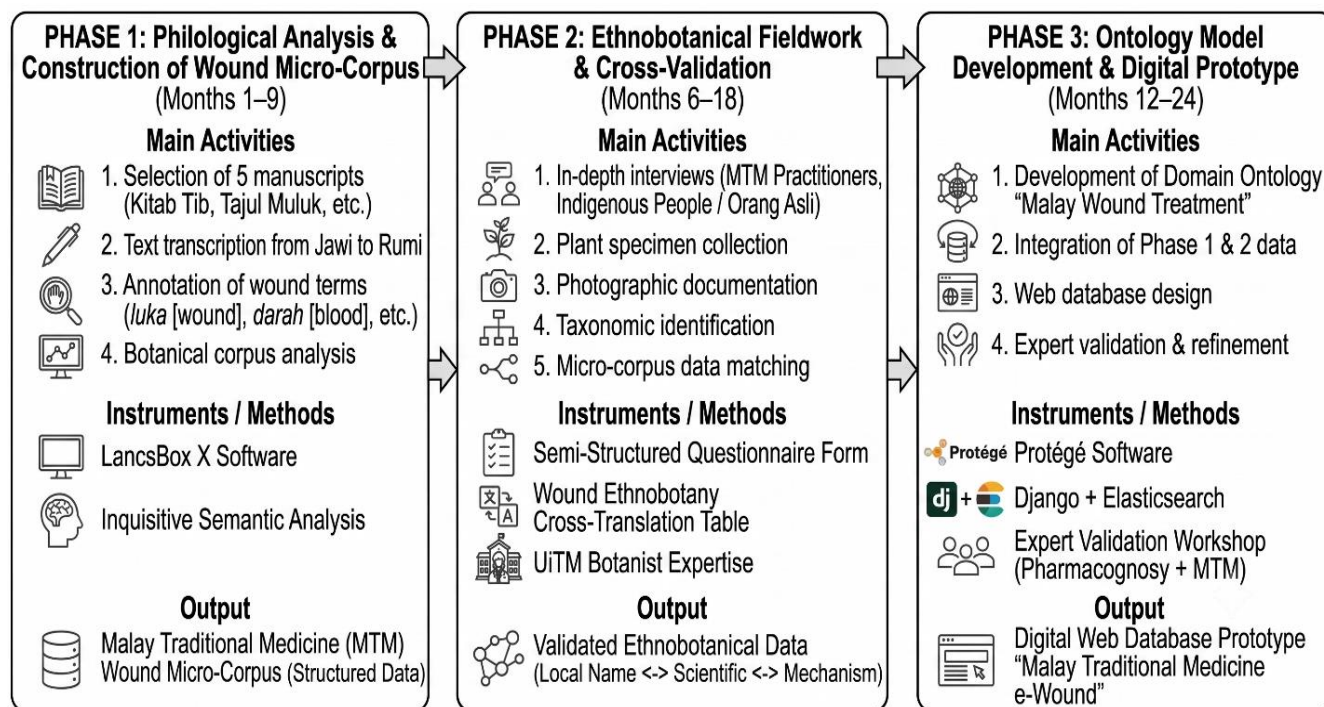
The creation of digital profiling frameworks is an essential undertaking. Digitalization facilitates the systematic mapping of ethnobotanical information, including indigenous and scientific nomenclature, while safeguarding the intellectual property rights of the Malay community. Investigations focused on the scientific modelling of this information correspond with worldwide objectives to incorporate traditional medicine into conventional healthcare. The Ministry of National Unity states that, through manuscript digitisation efforts, information about Malay medical practitioners is now recognized as a legitimate scientific resource for the development of future nutraceutical and pharmaceutical products (Amil et al, 2024). In contrast to current databases that are either unchanging or serve solely as digital repositories, the methodology outlined in this concept paper, the creation of the Malay Wound Care Ontology Model, provides a dynamic framework that interlinks Wound Type, Plant (both local and scientific nomenclature), Source Manuscript, and Pharmacological Mechanism entities within a searchable and analytically sophisticated data structure. This allows scholars and professionals across various fields to access comprehensive information, thereby closing persistent knowledge gaps.

DISCUSSION

Transdisciplinary Research Conceptual Framework

This concept paper outlines a transdisciplinary research framework that functions via three successive and interrelated periods (see Figure 1). This paradigm integrates the humanities (philology and corpus linguistics) with applied sciences (ethnobotany, pharmacology, and computer science), in contrast to traditional, segmented methods. This integration facilitates the systematic, inclusive, and validated translation of indigenous knowledge. This methodology entails that data derived from ancient Malay medical texts are both philologically recorded and validated against contemporary community behaviours, ultimately culminating in their translation into an interactive digital ontology platform.

Figure 1 Conceptual Framework Model of Transdisciplinary Research



The initiation of Phase 1 involves selecting key manuscripts, such as Kitab Tib (MS 2992), Tajul Muluk, and specific Terengganu medical writings, chosen for their geographical and temporal diversity to ensure an extensive representation of Malay medical traditions. The Jawi-written documents are subsequently copied exactly into Rumi script, with an emphasis on terminology related to wounds, including words like wound, venom, blood, pus, swelling, fracture, poison, bullet, machete, and fire. Following this, the standardized Rumi texts are examined using LancsBox X software to generate concordances and frequency lists of botanical terms, revealing collocation patterns, mention frequencies, and semantic connections between plant species and treatment approaches. Ultimately, literary dissection and probing semantic examination (Jalaluddin, 2014) are utilized on the extracted terminology to reveal the cultural conceptualization, indigenous cognition, and symbolic significance of the Malay community regarding wound occurrences and healing methodologies. The culmination of these stages results in the establishment of the Malay Traditional Wound Medicine Micro-Corpus, a meticulously organized text database comprising plant entries, original citations, literal translations, and initial epistemological analyses.

Phase 2 conveys textual discoveries to the field via ethnographic methodologies involving Malay medical practitioners affiliated with the Ministry of Health Malaysia (MOH), the Malay Traditional Medicine Association of Malaysia (PUTRAMA), traditional midwives, and Orang Asli communities in Peninsular Malaysia. This stage emphasises ethical research, specific methodologies, and informed consent. Utilizing purposive sampling, the selection of informants includes Malay medical practitioners affiliated with MOH facilities (including Cheras Rehabilitation Hospital, Putrajaya Hospital, Selayang Hospital, Sultan Ismail Hospital, Johor Bahru, Raja Permaisuri Bainun Hospital, Ipoh, Kepala Batas Hospital, Tengku Ampuan Afzan Hospital, and Sultanah Nur Zahirah Hospital), private treatment centers (such as Al-Hidayah Treatment Center, Urban Retreat Onsen, and Melaka Heritage Treatment Centre), as well as customary leaders from the Orang Asli community.

Extensive ethnobotanical information, including vernacular nomenclature, wound causation (lacerations, thermal injuries, insect bites, bone fractures), preparation techniques (crushed, used as a poultice, simmered, oil-infused), and ceremonial customs or prohibitions, is gathered via semi-structured interviews. Field plant specimens are subsequently photographed and taxonomically authenticated by UiTM botanists before being conserved as voucher specimens in reference herbaria. Ultimately, regional nomenclature is aligned with the Phase 1 micro-corpus via the Wound Ethnobotanical Cross-Translation Table as specified in Table 1.

Table 1 Wound Ethnobotanical Cross-Translation Table (Multiple Species)

Istilah Manuskrip	Tafsiran Patofisiologi Moden	Mekanisme Herba Diperlukan	Calon Species Tempatan
Venomous wound	Bacterial infection, acute inflammation	Antimicrobial, anti-inflammatory	Gelam (<i>Melaleuca cajuputi</i>), Akar Danan
Dirty blood	Necrosis, slough formation	Enzymatic debridement, astringent	Manggis (<i>Garcinia mangostana</i>), Kunyit (<i>Curcuma longa</i>)
Cooling the wound	Analgesia, vasoconstriction	Analgesic, anti-pyretic	Pegaga (<i>Centella asiatica</i>), Lidah Buaya (<i>Aloe vera</i>)
Adding flesh	Angiogenesis, fibroblast proliferation	Cell growth stimulant	Minyak Kelapa Dara (<i>Cocos nucifera</i>), Senduduk (<i>Melastoma malabathricum</i>)

Phase 3 represents the central innovation in information science for this project, wherein all curated material from Phases 1 and 2 is amalgamated into a cohesive digital knowledge structure. This progression is categorised into two primary elements. The initial element entails the creation of the "MTM Wound Care" domain ontology utilizing Protégé software, whereby primary classes like Wound Type, Plant, Manuscript, Bioactive Compound, and Preparation Method are systematically linked via semantic relationships. This framework facilitates sequential mapping that correlates specific wound types with plant species, original publication citations, bioactive constituents, and preparation techniques.

The second element emphasises the amalgamation of data and the advancement of the "e-Luka" platform. Micro-corpus and ethnobotanical information are harmonised in accordance with global taxonomic criteria like Plants of the World Online, while the prototype of the "e-Luka Perubatan Tradisional Melayu" web database is constructed utilizing the Django framework and Elasticsearch search engine. This engine incorporates sophisticated search algorithms that can cross-reference colloquial dialects and archaic Jawi orthography, allowing users to conduct intricate searches like "diabetic wound in Kitab Tib" and obtain results that showcase species, biomedical processes, and the original manuscript text concurrently. To ensure functionality and ontological precision, this digital prototype is assessed through interactive workshops with autonomous expert panels comprising pharmacognosists and senior Malay medical practitioners.

Pilot Study: Methodological Validation Through *Chromolaena odorata* (Pokok Kapal Terbang)

To assess the reliability and consistency of this three-phase approach, a preliminary investigation was conducted using *Chromolaena odorata* (pokok kapal terbang) as a proof of concept. The choice of this species was motivated by three strategic rationales. To begin, *C. odorata* is supported by an extensive collection of contemporary scientific research, facilitating comprehensive cross-validation (See Table 2). Secondly, this plant is widely available and prevalent in local ecosystems, making it an exemplary model for developing cost-effective primary health interventions. Third, a contradiction of epistemological position arises when *C. odorata* is designated as an invasive weed in agricultural discussions (Rai & Singh, 2024; Otabor et al., 2025), while simultaneously being esteemed as a principal cure for wound bleeding in local ethnomedicine (Kodoh et al., 2017). The application of the "Cross-Translation Table" to *C. odorata* revealed an impressive correspondence between conventional ethnomedical terminology and contemporary scientific research, as illustrated in Table 2. These preliminary findings demonstrate that Malay medical narratives are not solely anecdotal but have empirical legitimacy consistent with contemporary biomedical standards. The achievement of this mapping validates that the suggested methodology is sound and may be used for all plant species involved in wound healing, as derived from the chosen texts.

Table 2 Example of *C. odorata* Traditional Claims (Pilot Case) with Scientific Evidence

Istilah Tradisional	Konteks Perubatan	Mekanisme Patofisiologi Modern	Rujukan Saintifik	Tahap Padenan
Stop bleeding	Controlling bleeding from a fresh wound	Vasoconstriction, Haemostasis, procoagulant activity	Pandith et al. (2013); Li et al. (2024)	High
Reduce pain	Alleviating wound-associated pain/stinging	Analgesic & anti-inflammatory activity mediated by modulation of inflammatory pathways	Vijayaraghavan et al. (2017); Owoyele et al. (2008)	High
Dry the wound	Reducing wound exudate	Promotion of epithelialisation and tissue regeneration	Lun et al. (2023); Abdul Latif et al. (2024)	Medium High
Purulent wound	Treatment/supportive management of infected wounds	Broad-spectrum antimicrobial activity against wound-associated pathogens	Paul et al. (2026); Alabi et al. (2019)	High

Comparison with Major World Traditional Medicine Approaches

As outlined in Table 3, the proposed MTM framework distinguishes itself from TCM and Ayurveda in four key respects. From an epistemological perspective, Traditional Chinese Medicine (TCM) is grounded in Yin-Yang relational theory, whereas Ayurveda is based on the equilibrium of humoral Doshas; in contrast, the MTM framework utilizes a pragmatic Cross-Translation Table method that correlates colloquial wound-care terminology with established pathophysiological processes (e.g., haemostasis, epithelialization), thus establishing a practical connection between traditional methodologies and contemporary biomedical science.

Table 3 Comparison of the Proposed PTM Framework with International Traditional Medicine Systems

Ciri Pendekatan	Traditional Chinese Medicine (TCM)	Ayurveda (India)	Malaysia Traditional Medicine (MTM)
Epistemological Translation	Focused on qualitative Yin-Yang theory	Based on humoral concepts (Dosha: Vata, Pitta, Kapha)	Mapping vernacular terms to modern pathophysiological mechanisms (Cross-Translation Table)
Priority Metrics	Energy balance (Qi)	Body constitution balance	Expert validation, computational corpus linguistics & ontology entities
Source Integration	Dominated by canonical written Chinese texts	Dominated by Vedic texts & Samhitas	Expert validation, computational corpus linguistics & ontology entities
Ethics & Intellectual Property	Governed by national regulatory control	TKDL (Traditional Knowledge Digital Library)	Integrating CARE Principles & Nagoya Protocol

STUDY LIMITATIONS

This concept paper openly recognises many methodological and conceptual constraints that must be tackled in future empirical studies. From a broader viewpoint, the initial results disclosed are derived from the synthesis of secondary data, necessitating further philological analysis to validate the references to *Chromolaena odorata* in primary texts like *Kitab Tib*, owing to the evolving characteristics of historical vernacular language. Moreover, the interpretation of conventional medical terminology related to humoral theories, including "hot" and "cold" attributes, necessitates meticulous cultural contextualisation to prevent scientific assessment from becoming overly simplistic or dismissive of indigenous knowledge systems in favour of contemporary scientific paradigms.

Proposed Research Directions

Figure 2 illustrates a research roadmap constructed on a 24-month schedule that successively incorporates a Gantt Chart and a three-phase procedure. Implementation begins with the preparatory stage and Phase 1 (Months 1-9), focusing on the philological examination of DBP/PNM manuscripts, Jawi-Rumi transcription, and corpus analysis using LanksBox X to establish the MTM Wound Micro-Corpus database. Following this, Phase 2 (Months 6-18) disseminates results to the field through ethnographic studies involving MOH practitioners, PUTRAMA, and Orang Asli communities for specimen collection, taxonomic classification by botanists, and the integration of ethnobotanical data. The execution concludes in Phase 3 (Months 12-24) with the creation of a domain ontology (using Protégé), data amalgamation, and the development of the "e-Luka" intelligent search web prototype utilising Django and Elasticsearch, followed by assessment through expert validation workshops.

Figure 2 delineates three primary output types to facilitate the effective application of research findings within academic discourse and industry. This study integrates ethnobotanical information, phytochemical characteristics, and Linnaean classification into the Malay Wound Care Ontology Model as theoretical frameworks. For novel offerings, it develops the interactive "e-Luka" digital platform featuring advanced search functionalities spanning Jawi orthography and regional dialects. Ultimately, regarding publications and intellectual property, this initiative aims to create an Electronic Encyclopedia of "Wound-Healing Plants" (interactive PDF), two high-impact journal articles (Scopus/WoS), and secure database copyright registration to uphold epistemological justice and safeguard the knowledge of local wisdom bearers.

This study is a strategic initiative to convert Malay ethnobotanical knowledge from historical manuscripts into valuable national resources. From a socio-cultural and heritage conservation viewpoint, this digital profiling serves as a mechanism for salvaging traditional medical knowledge from severe extinction due to the lack of formal successors, while reinforcing national identity sovereignty by establishing Malaysia as a global reference center for Malay Traditional Medicine (MTM), akin to Traditional Chinese Medicine (TCM) and Ayurveda.

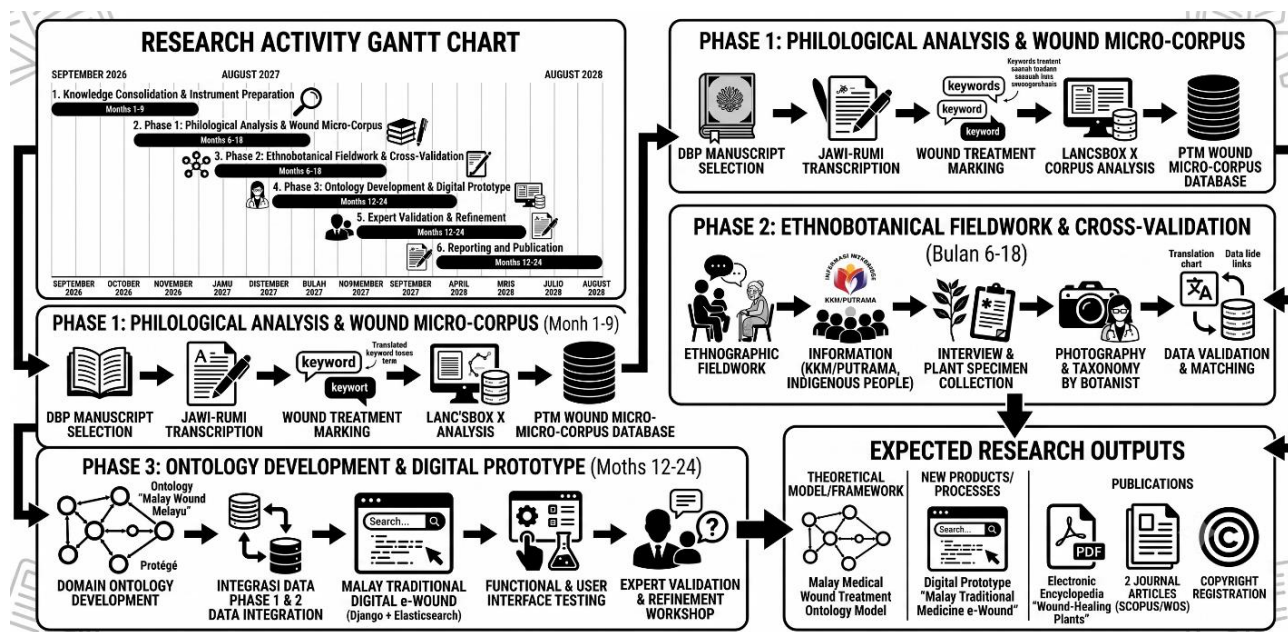
Validated ethnobotanical data offers a targeted R&D "roadmap" for the local pharmaceutical and nutraceutical sectors to reduce pre-clinical research expenses, grounded in robust historical evidence, while simultaneously bolstering rural economies through organised high-value herbal farming. From the perspectives of policy and public health, the research results advocate implementing the National Traditional and Complementary Medicine Policy by providing empirical data that facilitate the safe integration of Malaysian traditional practitioner practices into conventional health systems.

This organised record serves as crucial evidentiary material for asserting national biocultural sovereignty in accordance with the Nagoya Protocol, thereby safeguarding Malaysia's intellectual property rights over genetic resources against biopiracy risks and the risk of non-equitable benefit-sharing. This interdisciplinary collaboration cultivates new human resources who connect the humanities (philology) with applied sciences (botany and pharmacology).

This study offers significant enhancement to DBP's 2026 Strategic Planning (Thrusts 1, 2, and 4) by re-examining ancient medical vocabulary and creating an illustrated digital encyclopedia to augment the

linguistic corpus and conventional scientific terminology. This framework at the global scale correlates national accomplishments with the UN Sustainable Development Goals (SDGs), including SDG 3 (Health and Well-being via innovative herbal treatments), SDG 4 (Quality Education rooted in cultural diversity appreciation), SDG 15 (Conservation of Biodiversity), and SDG 16 (Safeguarding Traditional Knowledge Rights of Under-represented Communities).

Figure 2 Research Directions for Transdisciplinary Research Conceptual Framework Impact and Outcomes



CONCLUSION

This concept paper introduces a transdisciplinary research framework that combines philological examination, ethnographic investigation, and digital ontology development to connect traditional Malay medicine with contemporary biomedical science. A pilot investigation of *Chromolaena odorata* reveals that local knowledge, frequently dismissed as folklore, has empirical validity and aligns with recognised pathophysiological processes, such as haemostasis, epithelialisation, and antibiotic effects. The effective correlation of colloquial wound-care terminology with contemporary scientific frameworks substantiates the methodological soundness of the suggested Cross-Translation Table technique, affirming its relevance to the entire range of plant species recorded in Malay medical texts. The suggested "e-Luka" digital platform, based on FAIR data principles and CARE ethical standards, ensures that the rejuvenation of traditional Malay medicine occurs through equitable collaboration with knowledge-holding communities rather than exploitative extraction, protecting intellectual sovereignty and facilitating fair benefit-sharing in accordance with the Nagoya Protocol. This three-phase framework ultimately provides a strategic plan for converting Malay ethnobotanical heritage from a historical artefact into a dynamic, scientifically validated, and ethically managed resource for global health advancement, in accordance with Malaysia's national objectives and the United Nations Sustainable Development Goals.

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REFERENCES

1. Abdallah, H. (2024). Redefining science for sustainable development: The nexus of endogenous knowledge systems and scientific paradigms. *International Journal for Multidisciplinary Research (IJFMR)*, 6(5), 1-14.
2. Abdul Latif, M., Mustafa, A., Keong, L. C., & Hamid, A. (2024). Chromolaena odorata layered-nitrile rubber polymer transdermal patch enhanced wound healing in vivo. *Plos one*, 19(3), e0295381.
3. Ahmad, S. (2002). Traditional medicine in Southeast Asia with special reference to Malaysia and Indonesia. In *Geography, Culture and Education* (pp. 51-64). Dordrecht: Springer Netherlands.
4. Alabi, M. A., Olusola-Makinde, O., & Oladunmoye, M. K. (2019). Evaluation of phytochemical constituents and antibacterial activity of *Chromolaena odorata* L. leaf extract against selected multidrug-resistant bacteria isolated from wounds. *South Asian J Res Microbiol*, 5(3), 1-9.
5. Amil, M. A., Koo, J. H., Yah, X. Y., Salam, N. A., & Zakaria, M. M. (2026). Microbial Contamination in Hard-Shell Capsule Traditional Medicines and Health Supplements in Malaysia: GMP Regulatory Oversight and Encapsulation Practices. *Germs*, 16(2), 9.
6. Aziz, N. A., Mohamad, M., Mohsin, H. F., Mohamad Nor Hazalin, N. A., & Abdul Hamid, K. (2020). The pharmacological properties and medicinal potential of *Chromolaena odorata*: A review. *International Journal of Pharmaceuticals, Nutraceuticals and Cosmetic Science (IJPNACS)*, 2, 30-41.
7. Aziz, M. H. A., Yusoff, A. N. M., & Magima, M. M. (2023). The use of herbs according to the perspective of traditional Malay medicine in Selangor, Malaysia. *International Journal of Academic Research in Business and Social Sciences*, 13(12), 1102–1115.
8. Che Hassan, N. H., Wan Mohd Saman, W. S., & Shaifuddin, N. (2023). Balancing sustainability factors in the implementation of digital libraries for Malay manuscripts: A framework proposal. *Journal of Information and Knowledge Management (JIKM)*, 2(SI), 242-263.
9. Coque, T. M., Cantón, R., Pérez-Cobas, A. E., Fernández-de-Bobadilla, M. D., & Baquero, F. (2023). Antimicrobial resistance in the global health network: known unknowns and challenges for efficient responses in the 21st century. *Microorganisms*, 11(4), 1050.
10. Ding, C. M. (2014). The application of Malay indigenous scientific and technical knowledge in the production of Malay manuscripts. *Persidangan Antarabangsa Manuskrip Melayu*, 3(1), 1-12.
11. Fauzi, N., Najid, M. H. M., Ibrahim, N., & Sahbudin, M. A. (2025). Digitalizing Malay Medical Manuscripts: A Database-Driven Approach to Preservation, Knowledge Management and Intellectual Property. *Journal of Al-Tamaddun*, 20(2), 199-210.
12. Fredriksson, M. (2022). Balancing community rights and national interests in international protection of traditional knowledge: a study of India's Traditional Knowledge Digital Library. *Third World Quarterly*, 43(2), 352-370.
13. Hadi, A. C., & Harun, J. (2022). Analisis filologi dan medik dalam manuskrip Kitab Tib: Satu pendekatan transdisiplin. *Jurnal Melayu*, 21(1), 45–60.
14. Harun, J. (2015). *Kitab Tib: Warisan khazanah intelek Melayu*. Dewan Bahasa dan Pustaka.
15. Harun Mat Piah. (2006). Traditional Malay Medicine from Old Malay Texts. *International Journal of the Malay World and Civilisation (Iman)* 3(3), 2015: 3-17.
16. Jalaluddin, N. H. (2014). *Semantik dan Akal Budi Melayu*. Bangi: Penerbit Universiti Kebangsaan Malaysia.
17. Kodoh, J., Mojiol, A. R., Lintangah, W., Gisiu, F., Maid, M., & Liew, K. C. (2017). Traditional knowledge on the uses of medicinal plants among the ethnic communities in Kudat, Sabah, Malaysia. *Int. J. Agr. Forest. Planta*, 5, 79-85.
18. Li, H.F., Feng, H., Wang, Y., Pan, Z.C., Yin, L., Qiu, H.L., Qiao, H., Zhao, J.Q., Xia, X.Y., Hou, J.C. and Wang, R.X.,(2024). Evaluation of hemostatic, anti-inflammatory, wound healing, skin irritation and allergy, and antimicrobial properties of active fraction from the ethanol extract of *Chromolaena odorata* (L.) RM King & H. Rob. *Journal of Ethnopharmacology*, 331, 118330.
19. Luu, N. D. H., Do, T. D. N., Nguyen, T. T. T., Nguyen, T. T. T., Nguyen, T. P., Hoang, L. S., & Tran, N. Q. (2023). Topical cream based on nanoformulation of *Chromolaena odorata* extract for accelerating burn wound healing. *Journal of Drug Delivery Science and Technology*, 82, 104360.

20. Nazir, A., Nazir, A., Zuhair, V., Aman, S., Sadiq, S. U. R., Hasan, A. H., Tariq, M, Rehman, L.U., Mustapha, M.J. & Bulimbe, D. B. (2025). The global challenge of antimicrobial resistance: mechanisms, case studies, and mitigation approaches. *Health Science Reports*, 8(7), e71077.
21. Owoyele, B. V., Oguntoye, S. O., Dare, K., Ogunbiyi, B. A., Aruboula, E. A., & Soladoye, A. O. (2008). Analgesic, anti-inflammatory and antipyretic activities from flavonoid fractions of *Chromolaena odorata*. *Journal of Medicinal Plants Research*, 2(9), 219-225.
22. Pandith, H., Zhang, X., Liggett, J., Min, K. W., Gritsanapan, W., & Baek, S. J. (2013). Hemostatic and wound healing properties of *Chromolaena odorata* leaf extract. *International Scholarly Research Notices*, 2013(1), 168269.
23. Paul, R., Hazra, A., Chatterjee, S., Biswas, R., Choudhury, S.S., Mitra, A.K., Uti, D.E. and Dhara, B.(2026). *Chromolaena odorata*: An Ethnobotanical Herb with a Wide Spectrum of Pharmacological Activities. *Natural Product Communications*, 21(3), 1934578X261429665.
24. Pranata, A., Rahayu, H. M., & Qurbaniah, M. (2025). Pengembangan buku saku etnobotani jamu pasca melahirkan pada masyarakat Melayu. *Didaktika Biologi: Jurnal Penelitian Pendidikan Biologi*, 9(1), 31–39.
25. Otabor, J. I., Egbon, I., Toews, M. D., & Uyi, O. (2025). The Double-Edged Sword: Local Perspectives on the Spread, Impact, Management, and Uses of the Invasive *Chromolaena odorata* in Southern Nigeria. *Sustainability*, 17(8), 3514.
26. Rai, P. K., & Singh, J. S. (2024). Ecological insights and environmental threats of invasive alien plant *Chromolaena odorata*: Prospects for sustainable management. *Weed Biology and Management*, 24(1), 15-37.
27. Ramya, R., Othman, R., Hatta, F. A. M., & Wan, W. S. H. (2024). The Ethnobotanical Elements in Traditional Malay Medical Knowledge: A Review. *International Journal of Research and Innovation in Social Science*, 2903.
28. Sarwi, F. S., Winarto, Fatimah, S., Sari, EF, & Fadilah, AM (2026). Ethnoscience and local wisdom in science education for conservation: A systematic review with bibliometric mapping. *Multidisciplinary Reviews*, 9(7). Sa
29. Wang, J., Xu, C., Wong, Y. K., Li, Y., Liao, F., Jiang, T., & Tu, Y. (2019). Artemisinin, the magic drug discovered from traditional Chinese medicine. *Engineering*, 5(1), 32-39.
30. Yusoff, S. A., & Daud, H. (2013). *Kitab tib: Kaedah perubatan Melayu tradisional*. *International Journal of Creative Future and Heritage (TENIAT)*, 1(2), 107-114.
31. Vijayaraghavan, K., Rajkumar, J., Bukhari, S. N. A., Al-Sayed, B., & Seyed, M. A. (2017). *Chromolaena odorata*: A neglected weed with a wide spectrum of pharmacological activities. *Molecular medicine reports*, 15(3), 1007-1016.
32. Zakaria, F., & Zainal, H. (2017). Traditional Malay medicine in Singapore: a gramscian perspective. *Indonesia and the Malay World*, 45(131), 127-144.