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RESULTS OF SCIENTIFIC ACTIVITIES OF THE NATIONAL INSTITUTE OF MEDICINAL MATERIALS (2016–2025) AND DEVELOPMENT ORIENTATION TOWARD 2030

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Summary

This article provides a comprehensive review of the scientific and technological (S&T) activities of the National Institute of Medicinal Materials (NIMM), Ministry of Health of Vietnam, during the 2021–2025 period, and outlines strategic development orientations toward 2030 to mark the Institute's 65th anniversary (1961–2026). During 2021–2025, NIMM conducted 443 S&T research projects across national, ministerial, local, and grassroots levels; published 563 scientific papers (representing a 48.2% increase over the preceding period, including 135 international publications which alone saw an 82.4% increase); conferred 25 doctoral degrees; officially registered 10 medicinal plant varieties for commercial circulation; issued 97 technical procedures for medicinal plant breeding and production; isolated more than 250 pure compounds; established 27 reference compouds; and research & developed of 7 herbal pharmaceutical formulations. Research activities were systematically organised along a value chain spanning genetic resources, variety selection, chemical analysis and standardization, herbal drug formulation, and modernization of traditional medicines. In addition to these achievements, the article acknowledges persistent limitations regarding equipment and facilities, especially in the context of deep international integration in science and technology, as well as the adaptability of scientists to the new situation when implementing the Politburo Resolution No. 57-NQ/TW dated December 22, 2024 on breakthroughs in the development of science, technology, innovation, and national digital transformation, and the Law on Science, Technology and Innovation No. 93/2025/QH15. To leverage its strategic advantages and adapt to the evolving landscape, the Institute prioritizes research across the entire value chain, developing a diverse portfolio of medicinal products to enhance primary healthcare. Our mission remains steadfast in fostering in-depth and applied research driven by advanced science and technology, while elevating the collective research capacity to meet international standards. Moving forward, NIMM will focus on institutional and governance reforms, accelerating digital transformation, and establishing a comprehensive medicinal resource database. Furthermore, by implementing robust intellectual property protections and fostering public-private partnerships, we aim to drive revenue growth, strengthen institutional self-reliance, and improve the welfare and living standards of our staff.

Keywords: *National Institute of Medicinal Materials (NIMM); Scientific activities; 65th Anniversary; Development Orientation; Medicinal Materials.*

1. Introduction

The National Institute of Medicinal Materials (NIMM), established in 1961, is the leading research institute of the Ministry of Health of Vietnam in the field of medicinal materials and traditional medicine (TM/CAM). After 65 years of development (1961–2026), NIMM has grown into a nationally recognised **Center** for science and technology (S&T), fulfilling the mission of conducting comprehensive research spanning resource conservation, raw material development, and the production of high-quality herbal pharmaceutical products to serve public health care.

NIMM's organizational structure comprises 19 units and a director board (a general director and two deputy directors, four functional departments, five specialized departments, and nine research **Center**s distributed from North to South Vietnam, representing the country's diverse ecological zones. As of December 2025, the Institute employs 267 staff members, including five associate professors, 48 PhDs, and 93 Masters - a highly qualified scientific workforce trained domestically and abroad.

The 2021–2025 period unfolded in an exceptionally challenging context: the COVID-19 pandemic, sluggish global economic recovery, and complex geopolitical disruptions that profoundly affected all S&T activities. At the same time, this period witnessed the enactment of pivotal national policies that shaped NIMM's research agenda, including Politburo Resolution 57-NQ/TW (December 2024) on breakthroughs in the development of science, technology, innovation, and national digital transformation; Resolution 72-NQ/TW on a number of breakthrough solutions to strengthen the protection, care, and improvement of people's health; Prime Ministerial Directive 25/CT-TTg on advancing Vietnamese traditional medicine in the new era; and Prime Ministerial Decisions No. 376/QĐ-TTg and No. 1165/QĐ-TTg on developing the national pharmaceutical industry and Vietnamese pharmacy sector to 2030, with a vision to 2045. These regulatory frameworks created favourable conditions and provided critical impetus for NIMM to accelerate its research and development activities during this pivotal phase.

2. Major Sci-Tech Research Outcomes (2021–2025)

During 2021–2025, NIMM implemented a total of 443 S&T research projects, comprising:

17 at national-level, 27 at ministerial-level, 33 at provincial/local, 22 rural and mountainous projects, 02 international bilateral projects, and 342 at institute-level; NIMM served as the lead institution for 413 projects and as a collaborating partner for 30. The principal outcomes are presented below according to the medicinal materials value chain, from raw material creation to new drug development.

2.1. Raw Material Supply: Survey, Conservation, and Development of Medicinal Material Resources

Survey and construction of medicinal material databases: NIMM continued to survey and assess the status of medicinal plant resources across multiple ecological zones nationwide. The results documented 1,840 species and subspecies of medicinal plants belonging to 915 genera in the South-East region, and 1,113 species belonging to 565 genera in the South-West region. In the North-West highlands, in collaboration with the Hoang Lien National Park, NIMM established both in situ conservation gardens (10 ha) and ex situ conservation gardens (over 4 ha) to safeguard 400 accessions of 150 endemic and rare medicinal plant species. The Institute compiled and published **a total of seven specialised reference books** on medicinal plant genetic resources, **notably including** the Atlas of Vietnamese Medicinal Plants (Volumes I and II), each covering 50 commercially promising species.

Conservation and maintenance of genetic resources: NIMM maintains conservation of 964 accessions of 642 species/subspecies across five medicinal plant conservation gardens spanning the Red River Delta (Hanoi), the northern midlands (Tam Dao – Vinh Phuc), the northern highlands (Sa Pa – Lao Cai), the North-Central region (Thanh Hoa), and the South-East (Ho Chi Minh City). The seed bank now holds 1,006 seed accessions of medicinal plant germplasm and varieties. Notably, NIMM conducted systematic surveys to document the traditional medicinal plant knowledge of ethnic minority communities, including the Thai, H'Mong, Muong, Dao, Bru-Van Kieu, Churu, Ma, Jrai, Bahnar, M'Nong, and Khmer peoples across multiple provinces from north to south.

2.2. Variety Selection, Breeding, and Development of Medicinal Crop Growing Areas

Variety selection and official variety registration: NIMM conducted 26 variety selection projects, successfully selecting 15 medicinal plant varieties (including *Leonurus japonicus*, *Cassia tora*, *Salvia miltiorrhiza*, *Morinda officinalis*, *Hedyotis diffusa*, *Chrysanthemum morifolium*, *Ligusticum chuanxiong*, *Angelica acutiloba, Atractylodes macrocephala*, *Centella asiatica*, among others) and officially registering 10 varieties for commercial circulation. Approximately 60 accessions were evaluated for adaptability; six were successfully naturalised to reduce dependence on imported raw materials.

Development of technical procedures and technology transfer: A total of 97 technical procedures for seed propagation, cultivation, harvesting, primary processing, and storage of medicinal materials were issued, along with 50 institutional standards for seedlings and seeds, and 20 institutional standards for variety testing. NIMM transferred technical procedures for more than 25 medicinal plant species to 21 projects and supplied planting material to numerous medicinal material production and trading companies nationwide. Two major books were released includig Cultivation and Primary Processing Techniques for Medicinal Plants under GACP-WHO Standards (covering 35 species) and Seed Production Procedures for Medicinal Plants (covering 25 species).

2.3. Standardization and Quality Control of Medicinal Materials

This was the area of deepest investment by NIMM during 2021–2025, with the overarching aim of establishing a medicinal material quality assurance system aligned with international standards.

Development of a reference substance bank: NIMM isolated and characterised 26 reference compounds from medicinal plants, including carpain from *Carica papaya* leaves, piperine and pipercide from *Piper longum*, schisandrin and gomisin B from *Schisandra chinensis*, phyllanthin from *Phyllanthus amarus*, stevioside from *Stevia rebaudiana*, nuciferine from *Nelumbo nucifera* leaves, and others. These reference substances directly support analytical and quality-testing operations under the Vietnamese Pharmacopoeia V (VP V) standards.

Phytochemical research and database establishment: 248 pure compounds were isolated and their chemical structures elucidated from medicinal plants using state-of-the-art analytical techniques, including NMR (nuclear magnetic resonance spectroscopy), MS (mass spectrometry), LC-MS/MS, and HPLC-DAD. A phytochemical database was established for many herbal species and some species of the family Ganodermataceae (*Ganoderma flexibes*, *G. tropicum*, *G. cochlear*, *G. capense*, and *G. multipileum*). Eighteen standardised extract

preparation procedures and two synthesis procedures were developed (troxerutin and diosmin from hesperidin).

Construction of quality standards: Quality standards were completed for six processed herbal materials (aged Tangerine peel dry-fried to yellow, honey-roasted Astragalus, Achyranthes root, Sichuan lovage rhizome, Morinda root, and Kudzu root); 47 facility standards (TCCS) were established for crude drugs, herbal extracts, and preparations. Quality evaluation of market-traded medicinal materials was conducted at an average rate of 200 samples per year using chemical fingerprinting (HPLC fingerprint analysis) and DNA barcoding.

2.4. Pharmacological and Biological Activity Research

Nine new pharmacological models on experimental animals were established (a Parkinson's disease model on *Drosophila melanogaster*, *in vitro* and *in vivo* anticoagulation models, an experimental arthritis model, an *in vivo* breast cancer model on Balb/c mice, a diabetes-with-obesity model, and others), bringing the Institute's total validated pharmacological model repertoire to approximately 30 models. Research demonstrated several biologically significant activities: anti-thrombocytopenic activity of *Carica papaya* leaves, experimental menopausal symptom-ameliorating activity of *Vitex trifolia* fruits, and anti-tumour and immunomodulatory activities of selected Vietnamese medicinal plants. Systematic screening was performed across multiple pharmacological categories: anti-cancer, immunostimulatory, experimental anti-arthritic, *in vitro* tyrosinase-inhibitory, and stroke-preventive activities.

2.5. Pharmaceutical Formulation and Development of Novel Herbal Medicines

This constitutes the most strategically critical output of the medicinal materials value chain. During 2021–2025, NIMM developed seven herbal pharmaceutical products: film-coated Memonimm tablets from *Bacopa monnieri* for cognitive support; PapayUp preparations (film-coated tablets and syrup) for thrombocytopenia support in dengue fever; hard capsules of *Schisandra chinensis* extract for hepatoprotection; film-coated tablets of *Phyllanthus amarus* extract for liver function support and elevated liver enzymes; a gel and topical cream from *Capsicum annuum* (Trung Doan cultivar) for pain relief; preparations for cough relief (lozenges and syrup from *Platycodon grandiflorus*, *Iris domestica*, and *Coleus amboinicus* essential oil; lozenges and syrup from *Hedera helix* leaf extract); and topical skin products (nanoemulgel capsaicinoid, niosome resveratrol, and a skin-whitening product from curcumin and resveratrol). Fourteen pharmaceutical manufacturing procedures from herbal extracts were established. In 2024, the classical prescription Thong-ta-ninh was modernised by converting from granule to pellet form (targeting irritable bowel syndrome); in 2025, modernisation continued for the classical prescriptions Tan-duc-dan, Luong-phu-hoan, and Tam-ty-thang.

2.6. Human Resource Development and International Cooperation

Postgraduate training: During 2021–2025, NIMM recruited 29 new doctoral candidates and another 25 candidates have successfully defended their doctoral dissertations - a 150% increase over the 2016–2020 period. Collaborative training programmes with seven domestic universities and academies produced 23 PhDs, 48 Masters, and 210 undergraduate students; a further 1,100 students received practical training from pharmacy and medicine institutions nationwide. Memoranda of understanding were signed with seven domestic universities and academies.

International cooperation: Five international MOUs were signed: with the Kyoto Institute (Japan, 2024–2028), Seoul National University (Republic of Korea, 2023–2028), Kyushu University (Japan, 2023–2028), Jiangming University (China, 2020–2025), and Hong Ha University (China, 2025–2030). More than 30 international delegations from universities and research institutes in France, the United States, the Republic of Korea, Japan, China, Taiwan, Australia, Cuba, Russia, and Germany were received. Staff members were dispatched for short-term training and working visits to the Republic of Korea, Denmark, the United States, Japan, China, and Thailand.

2.7. Scientific Publications

As of December 2025, NIMM's cumulative scientific output reached 563 papers, a 48.2% increase over the 2016–2020 period (380 papers). This total includes 135 international publications (an increase of 61 papers, equivalent to +82.4%) and 428 domestic publications (an increase of 122 papers). The sharp growth in international publications reflects steadily improving research quality and the Institute's deepening integration into the global scientific community. The robust growth in international publications reflects the rising quality of our research and our active integration into the global scientific community. NIMM has successfully implemented the Digital Object Identifier (DOI) system and transitioned the *Journal of Medicinal Materials* to an online publishing platform

Table 1. Key S&T performance indicators: 2016–2020 versus 2021–2025

Indicator	2016–2020	2021–2025
Total S&T projects	487	**443**
National level (as lead institution)	46	**17**
Ministerial and provincial/local level	49	**60**
Total scientific publications	380	**563**
International publications	74	**135**
Domestic publications	306	**428**
Doctoral degrees conferred	9	**25**
Medicinal plant varieties officially registered	—	**10**
Technical procedures for medicinal material production	—	**97**
Herbal pharmaceutical formulations developed	—	**7**
isolated phytocompounds	—	**248+**
Reference compounds established	—	**26**

3. General Assessment

3.1. Achievements and outstanding results

First, NIMM's research activities have maintained their systemic character along a medicinal materials value chain - from resource surveys, genetic resource conservation, and variety selection, through GACP-WHO-compliant growing area development, quality standardization, and pharmacological research, to new drug formulation. This integrated competency is a distinctive strength shared by few research institutions in Vietnam.

Second, research quality has improved markedly. International publications increased by 82.4% compared with the previous period (from 74 to 135 papers), with numerous articles appearing in high-impact ISI-indexed journals. Total publications rose 48.2% to 563 papers over five years - clear evidence of the Institute's deepening integration into the global scientific community.

Third, the development of high-quality human resources exceeded expectations. The number of doctoral graduates increased by 150% compared with the preceding period (from 9 to 25). A cohort of young, rigorously trained scientists from reputable domestic and international institutions provides a solid foundation for NIMM's long-term development.

Fourth, NIMM expanded its research network by establishing additional research units - **Center** for Medicinal Material Resources, Highlands Research Center of Medicinal Materials, and Tam Dao Research Center of Medicinal Materials - thereby extending geographical coverage and multi-ecological-zone research capacity. Investments in research equipment during this phase have prioritized modern analytical machinery to facilitate advanced, in-depth research.

Fifth, NIMM demonstrated effective performance in its policy advisory role, contributing to the drafting and refinement of numerous important circulars and decrees in the pharmaceutical sector and providing substantive input to the Ministry of Health for the implementation of Resolution 72-NQ/TW and Directive 25/CT-TTg on the development of Vietnamese traditional medicine and pharmacy.

3.2. Limitations and shortcomings

Alongside these positive outcomes, certain persistent limitations must be acknowledged candidly. Regarding the scale and composition of projects: the total number of S&T projects across all levels declined compared with 2016–2020 (443 versus 487 projects), with a particularly notable decrease in national-level projects (from 46 to 17), attributable primarily to the contraction of the S&T budget in the aftermath of COVID-19. Research activities have not yet sufficiently engaged with industry demand and market requirements.

Regarding research quality and novelty: Research activities remained fragmented, lacking focus and in-depth resources, while investment in specialized research infrastructure was limited. There was a shortage of modern equipment and funding for drug research and development, especially clinical trials; thus, few new products were developed. The utilization of research infrastructures was far from optimized; many research projects have not achieved breakthroughs, and few have produced complete, commercially viable final products.

Regarding financial sustainability: income generated from S&T services and production activities remains limited, representing only approximately 10% of recurrent expenditure - insufficient to either meet the financial autonomy trajectory prescribed under Decree 60/2021/NĐ-or attract and retain talent.

Regarding management and organisational structure: administrative procedures for research management have not been substantially streamlined; investment remains dispersed rather than strategically concentrated. Newly established units have yet to complete their leadership teams and scientific staff. The Institute's performance

evaluation mechanisms lack systematic rigour and substantive depth.

4. Strategic Science and Technology Orientations for the Period of 2026–2030

The 2026–2030 period constitutes a pivotal juncture for the concurrent implementation of Politburo Resolution 57-NQ/TW on S&T breakthroughs, Prime Ministerial Directive 25/CT-TTg on traditional medicine development, and National Assembly Resolution 193/2025/QH15 providing exceptional mechanisms to accelerate S&T. Drawing on the results achieved and lessons learned, NIMM identifies five strategic orientations:

Restructuring Research along the Full Value Chain: Research will be refocused along a complete value chain – from genetic resources and high quality medicinal plant varieties to commercially viable products. Targets include: selecting and rehabilitating 20–25 new medicinal plant varieties and registering 50–60 varieties for circulation; establishing 25–30 GACP-WHO-compliant cultivation and primary processing procedures; developing innovative herbal medicines and modernization of traditional medicines. Priority therapeutic areas with high unmet need include musculoskeletal conditions, metabolic disorders, neurological conditions, and gastrointestinal diseases. Ten existing NIMM pharmaceutical products will be upgraded and optimised.

Upgrading the Quality Assurance and Testing System into a National Technical Infrastructure: Department of Analytical Chemistry and Standardization will be upgraded to ISO/IEC 17025:2017 accreditation, and the laboratories of Department of Pharmacology and Biochemistry to GLP acc. These initiatives establish a solid foundation for NIMM's integration into the pharmaceutical R&D value chain, in compliance with Ministry of Health regulations and WHO guidelines. Our focus on standardizing medicinal materials, semi-finished products, traditional medicines, and herbal drugs directly contributes to strengthening National Standards. In parallel, we are developing a comprehensive national electronic database on Vietnam's medicinal resources, advancing digital transformation in the sector.

Building Multidisciplinary Research Capacity: Recognizing this as the most significant gap in the current value chain, NIMM is committed to investing in pre-clinical research capabilities and supporting clinical trials for herbal medicines in strict accordance with ICH/GCP standards. This strategic move aims to meet domestic registration requirements and pave the way for international export. Furthermore, NIMM plans to restructure its specialized units into advanced research centers, expanding the scope of R&D to effectively address emerging challenges and opportunities in the medicinal materials sector..

Digital Transformation and Construction of a National Medicinal Materials Database: In alignment with Resolution 57-NQ/TW, NIMM will develop a comprehensive national electronic database for Vietnamese medicinal materials, integrating distribution, chemical composition, biological effects, and quality standards. Furthermore, we are establishing a centralized repository for medicinal extracts, phytochemicals, and reference standards, all managed through advanced digital information technology. This integrated infrastructure will serve as a powerful foundation for pharmaceutical research and development, ensuring precision and efficiency in every stage of drug discovery. It will apply OMICs (metabolomics, genomics) and DNA barcode technology in the identification and quality control of medicinal plants. The entire archive of medicinal plant documents, specimens, and knowledge on the use of traditional medicinal plants, will be digitized.

Intellectual Property Protection and Expansion of Public–Private Partnerships (PPP): NIMM will actively pursue patent registration, plant variety protection, and intellectual property rights enforcement, linking these to technology transfer agreements with industry. Sustainable PPP models will be developed with medicinal material enterprises, under which NIMM provides scientific and technological foundations while enterprises ensure commercial market linkages - creating a regenerative investment cycle for research. By 2030, the Institute aims to develop a high-quality workforce, significantly increasing the number of Professors, Associate Professors, and PhDs to lead pioneering research and foster academic excellence; a gene bank holding 2,000 accessions; and recognition as one of the leading medicinal material research institutes in South-East Asia.

5. Implementation Solutions

Reform of management mechanisms and strategic concentration of investment: The Institute will transition from dispersed to strategically concentrated investment, prioritising tasks that are critical to the value chain. An independent scientific council will be established to evaluate and select tasks on the basis of impact potential and transformative capacity. A performance-based research funding mechanism tied to deliverables will be applied in the spirit of Resolution 193/2025/QH15. ISO/IEC 17025- and GLP-accredited laboratories and a flagship specialised medicinal materials research **Center** will be established during 2026–2028.

Development and strategic deployment of scientific talent: Policies will be developed to attract leading scientists from abroad and from domestic institutions to NIMM. The quality of scientific staff will be continuously enhanced to meet the demands of medicinal material development. Management will be reformed to create an open scientific environment that encourages interdisciplinary and international collaboration.

Strengthening international cooperation and technology transfer: The MOU network will be expanded with leading universities and research institutes globally in the fields of medicinal materials and traditional medicine. Active participation in national S&T programmes and ministerial/provincial funding schemes will be sustained. Targets include: at least 5 patents, 10 registered medicinal plant varieties, and 1 herbal pharmaceutical product transferred to industry during 2026–2030.

Promoting application-oriented research to meet societal needs for medicinal material development: Revenue streams will be diversified through: ISO/IEC 17025-accredited analytical testing services; GACP-WHO advisory services for medicinal crop growing areas; commercialisation of high-quality medicinal plant varieties; and collaborative research contracts with industry partners to address practical societal needs.

Comprehensive digital transformation of Institute operations: A digitalised research management system will be implemented, covering task proposal, progress tracking, acceptance testing, and publication of results. A shared data platform will be established across all Institute units and external partners. Artificial intelligence (AI) and machine learning will be applied to big-data analysis in phytochemistry and biological activity screening.

6. Conclusion

Over 65 years of development, NIMM has consolidated its position as the leading research institute in the field of Vietnamese medicinal materials, with a comprehensive research system, a specialist scientific workforce, and an organisational network spanning all ecological zones of the country. During 2021–2025, notwithstanding the considerable challenges posed by the pandemic and global economic disruptions, the Institute achieved notable outcomes: published 563 scientific papers including 135 international publications which alone saw an 82.4% increase; conferred 25 doctoral degrees; officially registered 10 medicinal plant varieties for commercial circulation; issued 97 technical procedures for medicinal plant breeding and production; isolated more than 250 pure compounds; established 27 reference compouds; and research & developed of 7 herbal pharmaceutical formulations. These achievements have laid a solid foundation for a transformative breakthrough phase during 2026–2030.

For the 2026–2030 period, benefiting from the strong support of transformative policy mechanisms enacted by the Party and the State - in particular Resolution 57-NQ/TW and Directive 25/CT-TTg - NIMM charts a path of focused, high-quality development along the full medicinal materials value chain, tightly integrating research, training, production, and commercialisation. The overarching goal is to establish NIMM as an internationally recognised **Center** for medicinal materials S&T, making substantive contributions to the modernization of Vietnamese traditional medicine and pharmacy, and to the enhanced global competitiveness of Vietnamese medicinal materials.

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