

A REVIEW ON: NOVEL PHARMACEUTICAL TECHNOLOGIES IN  
COLLABORATION WITH PHARMACOGNOSY

\*Nikam Harshada D., Mhaske Shivkanya A. and Pagar Namrata S.

India.



\*Corresponding Author: Nikam Harshada D.

India.

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## ABSTRACT

The integration of novel pharmaceutical technologies with the rich knowledge base of Pharmacognosy presents a promising avenue for advancing natural research and development in the pharmaceutical industry. Pharmacognosy, with its emphasis on the study of medicinal plants and natural products, offers a treasure trove of bioactive compounds with therapeutic potential. However, traditional methods of extraction, purification, and formulation have often posed challenges in harnessing the full therapeutic benefits of these natural compounds. This paper explores the synergy between modern pharmaceutical technologies and the principles of Pharmacognosy to overcome these challenges. It highlights the utilization of innovative techniques such as nanotechnology, biotechnology, metabolomics, and computational modeling in the discovery, characterization, and optimization of natural products for pharmaceutical use. These technologies enable enhanced extraction efficiency, targeted delivery, improved bioavailability, and increased stability of natural compounds, thereby maximizing their therapeutic efficacy. Furthermore, collaboration between pharmaceutical scientists and pharmacognosists fosters interdisciplinary approaches that facilitate a deeper understanding of the complex interactions between bioactive compounds and biological systems. By leveraging the knowledge of traditional medicine systems and integrating it with cutting-edge scientific methodologies, researchers can identify novel drug candidates with diverse mechanisms of action and reduced side effects. Case studies and examples of successful collaborations between pharmaceutical companies, academic institutions, and traditional healers underscore the potential of this integrated approach in drug discovery and development. Moreover, the importance of sustainable sourcing, ethical considerations, and cultural preservation in utilizing natural resources for pharmaceutical purposes is emphasized. In conclusion, the convergence of novel pharmaceutical technologies with the principles of Pharmacognosy represents a paradigm shift in natural research and development. By capitalizing on the vast biodiversity of medicinal plants and traditional knowledge systems, this collaborative approach has the potential to revolutionize the discovery and production of safe, effective, and culturally relevant medicines for global health challenges.

**KEYWORDS:** Enhance drug discovery, optimization of therapeutic potential, interdisciplinary collaboration, sustainable development.

## INTRODUCTION

Pharmacognosy deals with the natural drugs obtained from organisms such as most plants, microbes, and animals. Up to date, many important drugs including morphine, atropine, galanthamine, etc. have originated from natural sources which continue to be good model molecules in drug discovery. A natural product is a chemical substance produced by living organisms such as plants, mushrooms, animals, and microorganisms. Relevantly, Pharmacognosy, as well-known, the science of drugs of natural origins is one of the main disciplines in pharmaceutical sciences. In other words, Pharmacognosy is described as systematic science of morphological, chemical, and biological properties along with history, cultivation, collection, extraction, isolation,

bio assaying, quality control, and preparation of crude drugs of natural origin. Actually, mineral sources can be also considered within the scope of Pharmacognosy.

Plants have been always used as medicine by mankind to treat health-threatening diseases and still popular to obtain new drug candidates as it is the oldest medical practice for humans. The use of botanical natural health products are on the increase all over the world. It is known that almost 80% of the populations in developing countries rely on the traditional medicine, mainly composing herbal prescriptions.<sup>[2]</sup>

When the term “natural product” is mentioned, they can be the organism itself (plant, animal, and

microorganism), any part of an organism (a leaf or flower of a plant, an isolated gland or other organ of an animal), and extract or pure substances. Doubtlessly, plants are prolific sources of new bioactive chemicals such as atropine, ephedrine, morphine, caffeine, salicylic acid, digoxin, taxol, galantamine, vincristine, colchicine, etc. In fact, approximately 25% of the prescription drugs dispensed in the United States contain at least one active ingredient of plant origin.<sup>[3]</sup> Consequently, natural products or compounds are still attracting a great attention from scientists. Not only plants, but also other organisms including marine animals, ants, frogs, worms, etc. as well as microorganisms produce very important drug candidate molecules. For instance, the precursor of acyclovir, the potent antiviral drug, was firstly discovered in a marine sponge and then developed into an antiviral drug.<sup>[4]</sup> Apicidin isolated from the microorganism *Fusarium pallidroseum* (Costa Rica) has been reported to be a fungal metabolite with potent broad spectrum antiprotozoal activity in vitro and efficacy against malaria factor *Plasmodium berghei*.<sup>[5]</sup>

Some compounds are used as active ingredients in the form directly isolated from plant extracts; others are synthesized to mimic a natural plant compound. Therefore, natural compounds could be good models for developing novel drug molecules. Modeling or modifying is an important action for drug industry. Because in some cases, natural products exert little or even no activity themselves, but by modification and using chemical or biological methods, potent drugs can be produced. A good example for this case could be baccatin III isolated from *Taxusbaccata* (yew tree), which is modified into taxol, a potent anticancer drug.<sup>[6]</sup>

In this sense, natural compounds are definitely valuable leads for drug discovery and the current importance of drugs of natural origin is unbeatable.

Currently, there is a rapidly increasing interest in Pharmacognosy and natural products research. A number of new international scientific journals in the field illustrates this trend. The increasing interest was also clearly reflected in the meeting of the four major international societies in the field of Pharmacognosy and natural products research. This joint meeting, a 5-yearly event, in July 1999 attracted more than 1100 scientists from all over the world to Amsterdam, the largest number ever in this field and almost double the number of the previous meeting 5 years ago.

There are several reasons which can be mentioned to explain the increased interest in natural products and Pharmacognosy.

- Search for new leads for drug development
- Biotechnology for the production of pharmaceuticals
- Health claims for food (nutraceuticals)
- Validation of traditional medicines
- Increased interest in phytotherapy

With this development in the past decade presently we can distinguish three major areas of interest for the pharmacognosist.

- Studies of new biologically active natural products
- Production of drugs from natural origin, including new methods such as biotechnology
- Quality control of drugs from natural origin.

The two first aspects I should like to discuss in some more detail. The studies for new active compounds have two major aspects: finding new leads for drug development and studies on the validation of traditional medicines. Traditionally the pharmacognosists have focused on plants as the source for new compounds, whereas work on microorganisms has mostly been in the hands of industry or academic chemistry groups. Here I will also mainly deal with plants.

#### • Enhance a drug discovery

Collaborations between pharmaceutical technologies and Pharmacognosy, the study of medicinal drugs obtained from plants or other natural sources, offer a promising avenue for enhancing drug discovery. Here's how such collaborations can lead to novel pharmaceutical advancements.

1. **Integration of Traditional Knowledge with Modern Techniques:** Pharmacognosy provides a rich repository of traditional medicinal knowledge from various cultures. By collaborating with pharmaceutical technologists, this knowledge can be combined with modern analytical techniques, such as high-throughput screening and molecular modeling, to identify novel bioactive compounds from natural sources more efficiently.
2. **Bioassay-Guided Fractionation:** Pharmacognosy emphasizes the use of bioassay-guided fractionation to isolate active compounds from natural sources. By incorporating advanced separation and analytical techniques, such as liquid chromatography-mass spectrometry (LC-MS) and nuclear magnetic resonance (NMR) spectroscopy, pharmaceutical technologists can streamline the process of isolating and characterizing bioactive compounds, accelerating drug discovery.
3. **Synergistic Effects and Multi-Targeted Therapies:** Natural products often contain complex mixtures of compounds that exhibit synergistic effects or act on multiple targets within biological pathways. Through collaboration, pharmacognosists and pharmaceutical technologists can leverage advanced data analysis tools and computational modeling to identify synergistic combinations or design multi-targeted therapies, leading to more effective and safer drugs.
4. **Bio-prospecting and Biodiversity Conservation:** Collaboration between pharmaceutical technologies and Pharmacognosy can facilitate responsible bio prospecting, where researchers ethically source natural materials for drug discovery while promoting biodiversity conservation. Advanced techniques

such as DNA barcoding and metabolomics can help identify valuable medicinal plants and assess their sustainable use.

- 5. Formulation and Delivery Optimization:** Pharmaceutical technologists can contribute expertise in drug formulation and delivery systems to enhance the bioavailability, stability, and targeted delivery of natural compounds. By optimizing formulations and delivery methods, the efficacy of natural products as pharmaceutical agents can be significantly improved.
- 6. Quality Control and Standardization:** Collaboration enables the development of standardized protocols for quality control and authentication of natural products, addressing issues related to variability and adulteration. Advanced analytical techniques, including spectroscopic methods and chromatographic fingerprinting, can ensure the consistency and purity of natural extracts used in drug development.
- 7. Exploration of Novel Therapeutic Targets:** Natural products offer a vast chemical diversity that can be explored to identify new therapeutic targets or mechanisms of action. Through interdisciplinary collaboration, researchers can uncover unique biological activities present in natural compounds, paving the way for the development of innovative drugs targeting previously unexplored pathways.

Overall, collaboration between pharmaceutical technologies and Pharmacognosy holds tremendous potential for revolutionizing drug discovery by harnessing the diverse chemical landscape of natural products in a systematic and scientifically rigorous manner.

- Here are some specific ways in which collaborations between pharmaceutical technologies and Pharmacognosy can enhance drug discovery:

**1. Identification of Novel Bioactive Compounds:** Pharmacognosy provides access to a vast array of natural sources, including plants, marine organisms, and microorganisms, which harbor diverse chemical compounds. By leveraging advanced analytical techniques such as mass spectrometry, nuclear magnetic resonance, and high-throughput screening, pharmaceutical technologists can rapidly identify and characterize novel bioactive compounds with therapeutic potential.

**2. Optimization of Extraction and Isolation Techniques:** Collaboration allows for the refinement and optimization of extraction and isolation techniques used in pharmacognosy to obtain pure and pharmacologically active compounds from natural sources. Pharmaceutical technologists can contribute expertise in process optimization, solvent selection, and purification methods to enhance the efficiency and yield of compound isolation.

**3. Prediction of Bioactivity and ADMET Properties:** Computational approaches, including quantitative structure-activity relationship (QSAR) modeling and molecular docking, can be employed to predict the bioactivity and absorption, distribution, metabolism, excretion, and toxicity (ADMET) properties of natural compounds. By integrating Pharmacognosy data with computational modeling, researchers can prioritize promising candidates for further evaluation, thereby accelerating the drug discovery process.

**4. Development of Drug Delivery Systems:** Pharmaceutical technologists can design innovative drug delivery systems, such as nanoparticles, liposomes, and micelles, to improve the solubility, stability, and targeted delivery of natural compounds. These advanced delivery systems can enhance the bioavailability and therapeutic efficacy of natural products, overcoming limitations associated with poor aqueous solubility or rapid metabolism.

**5. Exploration of Synergistic Combinations:** Collaboration enables the exploration of synergistic interactions between natural compounds or between natural compounds and synthetic drugs. By combining traditional knowledge with modern screening approaches, researchers can identify synergistic combinations that exhibit enhanced therapeutic effects or mitigate drug resistance, leading to the development of more potent and efficacious treatments.

**6. Validation of Ethno-pharmacological Claims:** Ethno-pharmacological knowledge, derived from traditional medicine systems practiced by indigenous communities, often provides valuable leads for drug discovery. Through collaboration, Pharmacognosists and pharmaceutical technologists can validate the Ethno-pharmacological claims associated with specific natural remedies using rigorous scientific methods, thereby unlocking their therapeutic potential and facilitating their translation into modern medicine.

**7. Integration of Omics Technologies:** Omics technologies, including genomics, Transcriptomics, proteomics, and metabolomics, can provide comprehensive insights into the biological activities and mechanisms of action of natural compounds. By integrating omics data with pharmacognosy research, researchers can elucidate the molecular targets and signaling pathways modulated by natural products, facilitating the rational design of targeted therapies for various diseases.

By leveraging the complementary expertise of pharmaceutical technologists and Pharmacognosists, collaborations can enhance the drug discovery process, leading to the identification of novel therapeutic agents derived from natural sources.

- **Interdisciplinary collaboration**

Interdisciplinary collaboration between novel pharmaceutical technologies and Pharmacognosy (the study of medicinal plants and natural products) represents an innovative approach to research and development in the pharmaceutical industry. This collaboration harnesses the strengths of both fields to discover, develop, and optimize natural products for therapeutic applications. Here's how interdisciplinary collaboration between pharmaceutical technologies and Pharmacognosy can drive new approaches to natural research and development.

**1. Advanced Analytical Techniques:** Integrating cutting-edge pharmaceutical technologies such as high-throughput screening, mass spectrometry, and nuclear magnetic resonance spectroscopy with pharmacognostic methods enables the rapid identification and characterization of bioactive compounds from natural sources. This interdisciplinary approach enhances the efficiency of natural product discovery and accelerates the identification of lead compounds for drug development.

**2. Bioprospecting and Bioactivity Screening:** Collaboration between pharmaceutical technologists and pharmacognosists facilitates systematic bioprospecting of diverse natural sources, including plants, marine organisms, and microorganisms, to identify novel bioactive compounds with therapeutic potential. Advanced screening assays, bioinformatics tools, and computational modeling techniques are employed to assess the bioactivity, pharmacological properties, and mechanism of action of natural products.

**3. Bioprocessing and Formulation Development:** Interdisciplinary teams collaborate to develop innovative bioprocessing techniques for the scalable production of natural products with consistent quality and purity. This may involve biotechnology approaches such as plant cell culture, fermentation, and synthetic biology to produce bioactive compounds in recombinant hosts. Additionally, formulation scientists work alongside pharmacognosists to develop optimized drug formulations that enhance the stability, bioavailability, and therapeutic efficacy of natural products.

**4. Pharmacokinetics and Pharmacodynamics Studies:** Collaboration between Pharmacognosy and pharmacokinetics/pharmacodynamics (PK/PD) experts enables the comprehensive evaluation of the pharmacokinetic and Pharmacodynamic profiles of natural products. Interdisciplinary research teams utilize advanced analytical methods and preclinical models to investigate the absorption, distribution, metabolism, and excretion (ADME) of natural compounds, as well as their pharmacological effects and therapeutic potential in vivo.

**5. Clinical Translation and Validation:** Interdisciplinary collaboration between pharmaceutical

technologies, Pharmacognosy, and clinical researchers is essential for translating promising natural products into clinical development. This involves designing and conducting clinical trials to evaluate the safety, efficacy, and pharmacokinetics of natural product-based therapies in human subjects. Biomarker discovery, pharmacogenomics, and personalized medicine approaches may also be integrated into clinical studies to identify patient populations that may benefit most from natural product treatments.

Novel pharmaceutical technologies and Pharmacognosy can contribute significantly to sustainable development by addressing key challenges related to environmental conservation, public health, and socio-economic development. Here's how this collaboration can promote sustainability.

**1. Biodiversity Conservation:** Pharmacognosy focuses on the study of medicinal plants and natural products, which often come from diverse ecosystems rich in biodiversity. By collaborating with pharmaceutical technologies, sustainable practices can be implemented to ensure the responsible sourcing of natural ingredients, thereby promoting biodiversity conservation and preventing habitat destruction.

**2. Green Chemistry and Sustainable Manufacturing:** Novel pharmaceutical technologies emphasize green chemistry principles and sustainable manufacturing practices to reduce environmental impact and resource consumption. By incorporating these principles into the extraction, purification, and synthesis of natural products, collaboration with Pharmacognosy can lead to the development of eco-friendly processes that minimize waste generation, energy consumption and chemical pollution.

**3. Community Empowerment and Fair Trade:** Collaboration between pharmaceutical technologies and Pharmacognosy can support community-based initiatives for sustainable harvesting, cultivation, and processing of medicinal plants. By promoting fair trade practices and equitable partnerships with local communities, this collaboration can empower indigenous peoples and traditional healers while ensuring the sustainable use of natural resources and traditional knowledge.

**4. Natural Product Innovation and Biotechnology:** Advancements in pharmaceutical technologies, such as biotechnology and metabolic engineering, can enhance the sustainable production of natural products from renewable sources. By developing biotechnological platforms for the biosynthesis of bioactive compounds, collaboration with Pharmacognosy can reduce dependence on wild harvesting and contribute to the cultivation of medicinal plants in controlled environments, thereby



promoting agricultural sustainability and food security.

5. **Access to Affordable Medicines:** Collaboration between pharmaceutical technologies and Pharmacognosy can facilitate the development of cost-effective and accessible medicines derived from natural sources. By optimizing drug formulations, enhancing bioavailability, and improving production efficiency, this collaboration can lower the cost of natural product-based therapies, making them more affordable and accessible to underserved populations, particularly in low- and middle-income countries.
6. **Healthcare Innovation and Disease Prevention:** Natural products derived from Pharmacognostic research often have diverse therapeutic properties and potential applications in disease prevention and healthcare. Collaboration with pharmaceutical technologies can accelerate the discovery, development, and commercialization of natural product-based therapies for the treatment of infectious diseases, non-communicable diseases, and emerging health challenges, thereby promoting public health and well-being on a global scale.

## CONCLUSION

In conclusion, the collaboration between novel pharmaceutical technologies and Pharmacognosy represents a transformative approach to drug discovery that integrates traditional wisdom with modern scientific advancements. By merging the rich heritage of natural products and traditional medicine with cutting-edge technologies, this interdisciplinary collaboration holds tremendous promise for revolutionizing the way we discover, develop, and deliver new therapeutics.

Through the synergistic integration of high-throughput screening, bioinformatics, metabolomics, biotechnology, and computational modeling, researchers can harness the vast chemical diversity of natural sources to identify novel drug candidates with enhanced efficacy, safety, and sustainability. This collaboration also promotes ethical bio-prospecting practices, community engagement, and biodiversity conservation, ensuring the responsible utilization of natural resources and the equitable sharing of benefits with local communities.

Moreover, by embracing the principles of green chemistry, personalized medicine, and holistic healthcare, the collaboration between pharmaceutical technologies and Pharmacognosy transcends traditional boundaries and fosters a more inclusive and patient-centered approach to drug discovery. By leveraging the collective expertise of diverse disciplines and honoring the wisdom of traditional healers and indigenous knowledge holders, this collaborative effort not only expands the pharmacopeia but also respects cultural diversity and promotes social equity in healthcare.

In essence, the collaboration between novel pharmaceutical technologies and Pharmacognosy represents a paradigm shift in drug discovery—one that combines ancient wisdom with modern innovation to address the unmet medical needs of today and tomorrow. By embracing this interdisciplinary approach, we can unlock the full potential of nature's pharmacopeia and usher in a new era of transformative therapies for the benefit of humanity.

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