

Pharmacognosy of Molecular and Nano Carriers

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Abstract

Positioned at the intersection of Pharmacognosy and molecular biology, molecular pharmacognosy has emerged as a novel intermediary discipline. This paper explores the techniques, significance, and landscape of molecular pharmacognosy. The primary emphasis of this manuscript includes the molecular characterization of medicinal raw materials, the phylogenetic history of medicinal plants, assessment and preservation of germplasm resources for medicinal flora, the study of endangered medicinal plant species, and the biosynthesis and bio-regulation of allelopathic compounds. A recent innovation in herbal drug discovery encompasses a holistic approach incorporating molecular methodologies. Since time immemorial, natural products, particularly plants, have served as the foundation for treating human ailments.

The foundation of modern medical concepts still lies in medicine. Tasking History, Chemical analysis first appeared in the early 19th century and the extraction and modification of herbal ingredients began. Standardization, extraction and identification of individual medicinal components. However, modern herbal medicine research addresses the needs of herbal medicine in modern medicine, which paves the way for the creation of new structures such as nanoparticles, microemulsions, matrix systems, solid dispersions, liposomes, SLNs, etc. Curcumin has been crafted into nanomicelle frameworks, nanotubular structures, and colloidal nanogels, which may be utilized individually or alongside other chemotherapy agents like paclitaxel.

Curcumin has been formulated into nanomicelle systems, nanotubes and colloidal nanogels, which can be used alone or in combination with other chemotherapy drugs such as paclitaxel.

Keywords: DNA marker DNA-M, Genetic diversity- GD, Molecular Biology- MB, Molecular pharmacognosy -MP, Pharmacognosy

Introduction

In the past, plants were a suitable source of medicine. This medicine was available in the form of a crude drug. Finally, information about medicinal plants is recorded in herbal literature. Discrimination was used in the 19th century active ingredients were used and analyzed in various treatments[1,2]. The quest to extract and analyze beneficial compounds from medicinal flora persists in the present day. In contemporary times, numerous molecular techniques are utilized to identify chemical constituents in herbal medicine specimens. Herbal remedies are derived from organic sources such as plants, animals, and minerals, and they serve medicinal, therapeutic, or medical functions. The examination of these raw substances (whether structured or unstructured) falls under the realm of pharmacognosy. The concept of pharmacognosy originated between 1811 and 1815 and was previously referred to as materia medica, the study of medicinal products or pharmaceuticals. The term itself combines two Greek roots: pharmakon (medicine) and gignosko (the act of acquiring knowledge) [3]. Subsequently, pharmacognosy became narrowly defined to encompass the study of natural drugs sourced from the plant, animal, and mineral kingdoms, either as crude or unrefined substances, or as initial derivatives like oils, waxes, gums, and resins[4].

As we enter the 21st century, the education and research in pharmacognosy have garnered attention from academic professionals around the globe. Although pharmacognosy may be substituted with terms such as phytochemistry or chemical biology in certain regions, research into natural products spans areas like analytical chemistry, discovery of bioactive compounds, advancements in bioanalysis methods, biocatalysis, biosynthesis, biotechnology, cellular biology, drug classification, clinical investigations, plant studies, cultivation of pharmaceuticals, ethnobotany, genetics, marine chemistry, microbial transformations, molecular biology, organic synthesis, pharmacology, phytochemistry, phytotherapy, traditional medicine standardization,

taxonomy, meat cultivation, and pharmacognosy itself [5]. Recently, the fields of pharmacognosy and natural product research have begun to be explored at the molecular level [6]. Molecular pharmacognosy represents a field dedicated to the classification, identification, cultivation, storage, and production of active compounds from plant sources on a molecular scale. The foundational theory of molecular pharmacognosy was first proposed [7] in 1995 in their work "Prospects for the Application of Molecular Biotechnology in Pharmacognosy," with a subsequent book published in 2006 [8,9].

This article outlines the history, evolution, and significance of molecular pharmacognosy.

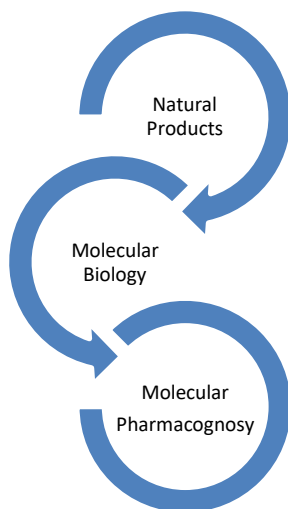


Fig. 1. Emerging trend of Molecular Pharmacognosy

Molecular pharmacognosy is an emerging field that merges molecular biology with pharmacognosy, tracing its roots in the evolution of Modern Biotechnology. Molecular biology plays a crucial role in identifying therapeutic plants by establishing and executing essential evaluations aimed at the molecular target of the organism.

Molecular pharmacognosy is a new discipline that combines molecular biology and pharmacognosy in its historical development of Modern Biotechnology. Molecular biology is important in terms of discovering medicinal plants by determining and performing the necessary tests for the purpose of the body towards the molecular target.

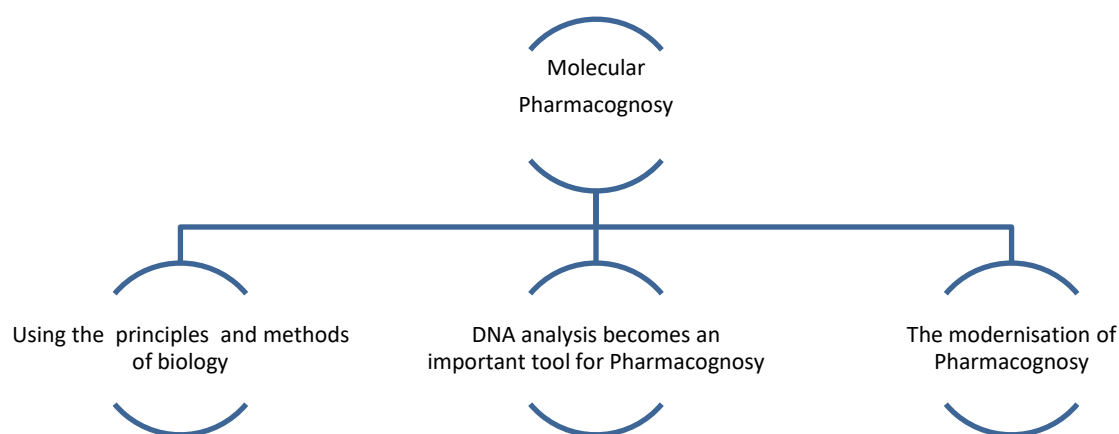


Fig. 2. Backbone of Molecular Pharmacognosy

Pharmacognosy at the Molecular level.

With the development of science and technology, especially biology and other disciplines, has enabled the development of pharmacognosy in the current context. Enter the 21st century, pharmacognosy studies are available, research topics are rapidly increasing, new technologies and new methods are constantly emerging from different Section These advances also have many problems. The following questions are good examples. How can it be done? What changes are described in drug products? Good medical products (especially What is the formation of liverwort, the molecular basis and environmental mechanism of this formation? What are the biological processes and effects of active substance accumulation in medicinal products? Is this method available? How to increase the active substance content? What are the properties of the material? Types of medical raw materials, what are the differences between raw materials, medical materials and herbal products? Important tools for discovery. Pharmacognosy covers all these areas as a diverse, interdisciplinary science [10].

Development of Molecular Pharmacognosy

The advancement of science and technology, particularly in biology and related fields, has facilitated the progression of pharmacognosy in today's landscape. For example, studies were conducted at the cellular level. In contrast to pharmacognosy, the purpose of molecular pharmacognosy is; Identification of specific molecules in medicinal products, examination of their biological background, elucidation of the molecular structure of the metabolite chain, understanding of the biosynthetic principles of secondary metabolites and providing a scientific basis for the production and preservation of herbal products [11]. This technology provides significant support for the detection of DNA polymorphism in molecular pharmacognosy.

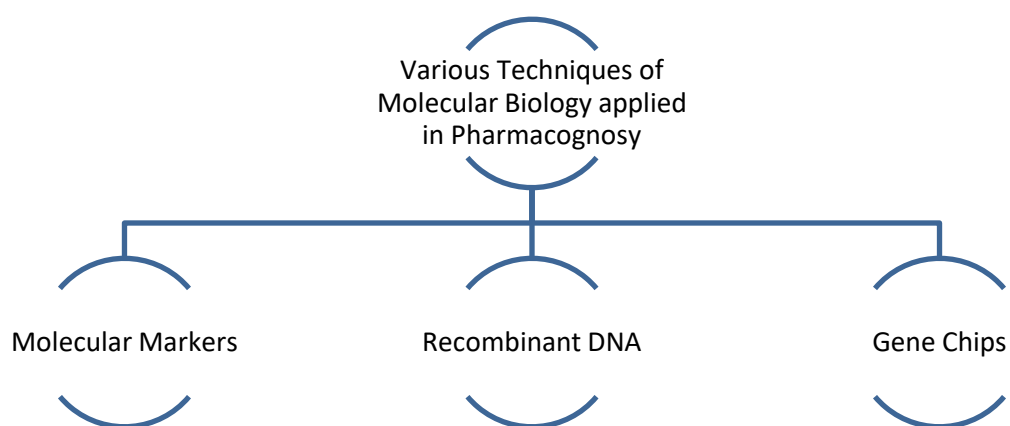


Fig. 3. Techniques of molecular biology applied to pharmacognosy

Molecular markers in herbal drug technology

Herbal innovation applies the wisdom of plants to create medicinal solutions, emphasizing the crucial roles of standardization and quality assurance through a harmonious blend of ancestral knowledge and contemporary science and technology. In the past, pharmacognosy only used medicinal products and the smell of raw drugs and drug-assisted behavior using chromatographic and spectroscopic methods to solve quality problems. Modern pharmacognosy includes all aspects of drug development and discovery, where applications based on molecular biology and biotechnology play an important role. Secondary metabolites are widely used as markers in quality control and modeling of botanical drugs. Molecular markers such as DNA markers are more accurate than phenotypic markers. DNA markers are reliable tools because the cosmetics of each species are unique and are not affected by external factors [12]. Various DNA-centric techniques for discerning species and detecting impurities in herbal medicines.

RAPD analysis for plant genetic study

RAPD is an efficient technique that can yield consistent profiles of composites. Genomes with no previous sequence data. The use of short random sequence primers during PCR provides a good example of the amplification of different genomic DNA sequences after gel electrophoresis. Most DNA data bands in RAPD are usually in the 300-3000bp range. It offers an economical, budget-friendly approach to evaluate variations. Additionally, it can assist in recognizing areas of diversity. Thus, molecular techniques serve as a robust instrument for genetic research [13]. Other molecular markers employed in Plant Genome Analysis include the following [14]:

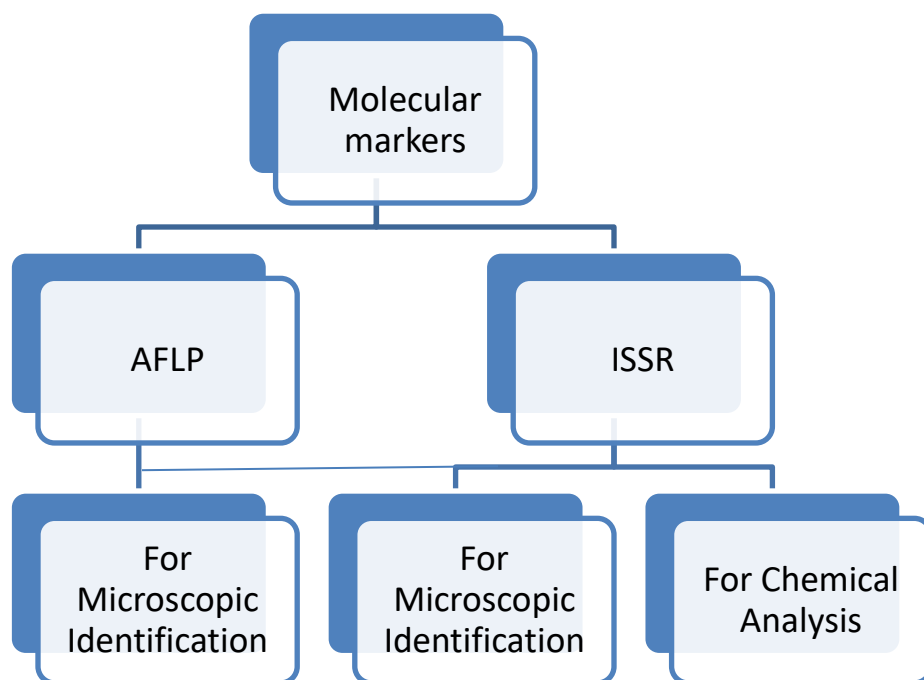


Fig. 4. Molecular markers

Quantitative estimation of DNA from different parts of same species

Contemporary techniques are employed to devise a straightforward, effective, dependable, and economical approach for the separation and quantification of various components. Pieces of genomic DNA from different parts of the same species. In this regard, a previous study by [14] in 2012 changed the method of ensuring DNA quality of CTAB. This method was determined to be the best method for isolating *Coleus* DNA from stems and leaves. Gel electrophoresis was used to analyze the difference in quality and quantity of DNA separation. The size of the isolated DNA is approximately ± 1200 bp. The A260/A280 ratios in the leaf and stem explants of the plant ranged from 1.6 to 1.9 (average approximately 1.8), indicating the purity level of the DNA. The resulting DNA is free of additives and displays minimal to no RNA impurities. The UV absorbance ratio for protein contamination (A260/280) and carbohydrate contamination (A260/230). To achieve a high-quality and pure nucleic acid preparation, the A260/280 ratio indicative of protein presence is crucial contamination should be greater than 2.0. The positive values of DNA obtained from leaves and stems were 3.7 and 0.40 $\mu\text{g/ml}$, respectively. Negative stem DNA may be due to factors such as RNA or protein synthesis, incorrect expression of transcription factors, or secondary metabolite interference. Aromatic herbs serve as a reservoir of natural compounds or bioactive elements that yield a significant array of secondary metabolites and therapeutically valuable medicines. It is known that plant cells contain large amounts of polysaccharides as well as active metabolites, which causes DNA isolation problems.

Emerging of Recombinant DNA technology for improvement in genetic variation

Recombinant DNA technology provides powerful tools that allow scientists to reconstruct DNA sequences generating genetically modified strains [15]

Gene chip technique

It is used to determine gene expression profiles, identify polymorphisms, create and screen genomic libraries. Mapping and hybridization arrays can be performed using gene chip technology.

Biotransformation

This method is mainly used to study the biosynthesis and accumulation of secondary metabolites obtained from planned sources [16]. Biotransformation is a chemical change carried out by bacterial/plant or animal cells. Bacteria or plant organisms act as catalysts. These involve easily identifiable chemical reactions catalyzed by enzymes present in the cell. Cells can be bacterial, plant or animal. Microbial organisms have the advantages of plant and animal cells with high surface area, rapid growth and high metabolic rate for efficient transformation. By using plants for biotransformation, important products such as cardiac glycosides, digoxin and benzoquinolines have been obtained. . It should be less painful and less potent.

Elicitor

Elicitors are substances that provoke various forms of plant defenses. Initiators include chemicals derived from bacteria (exogenous initiators) and compounds released by plants under the influence of bacteria (endogenous initiators). Elicitors can be used to increase the synthesis of secondary metabolites in plants and can play an important role in the biosynthetic pathway to increase the production of important plant components. Elicitors have been shown to inhibit the response and thus increase the release of secondary metabolites [17]

		Investigation of Plant defuse Mechanism
Elicitor	Plant Tissue Culture	Investigation of enzymology for secondary metabolism
		Increased Yield of Target Substance

Fig. 5. Utilization of Elicitation in various areas

Heart of Research in Molecular Pharmacognosy

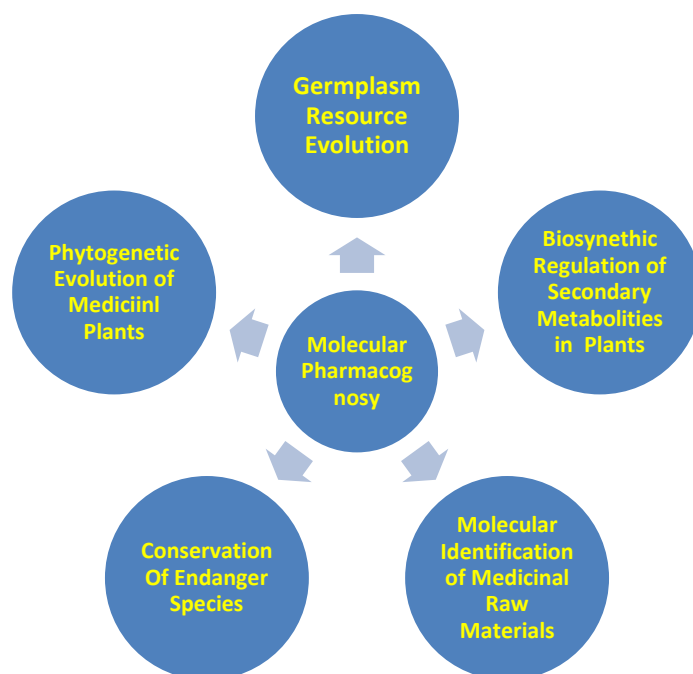


Fig. 6. Central core of molecular pharmacognosy

The above research areas are the main areas of molecular pharmacognosy and are related to pharmacognosy. Preparation, identification, investigation and historical research of herbal products. Herbal products deal with quality control and quality control of raw materials [18-19].

Current scenario for advancement in Molecular pharmacognosy

Combinatorial biosynthesis

The overarching idea behind combinatorial biosynthesis is the integration of metabolic pathways from various organisms at the genomic level. Recent advances in the biosynthesis of polyketides by bacteria (*Streptomyces*) are promising Chapter Combinatorial Biosynthesis. Examples of combinatorial biosynthesis include the biosynthesis of podophyllotoxin and paclitaxel in cell cultures [20].

Clinical pharmacognosy

Molecular methods and tools help in the discovery of medicinal plants by allowing accurate analysis of botanical data. This new discipline can expand the clinical scope of pharmacognosy and play an important role in the safe, effective and efficient use of drugs and herbs. Natural healing models may present certain unverified therapeutic advantages along with concealed toxicities and issues. Clinical pharmacognosy is the combination of botanical medicine and clinical research knowledge and provides clinical scientists, pharmacists, physicians and other healthcare professionals with the essential information needed to facilitate the advancement of medicinal plants and herbs [21].

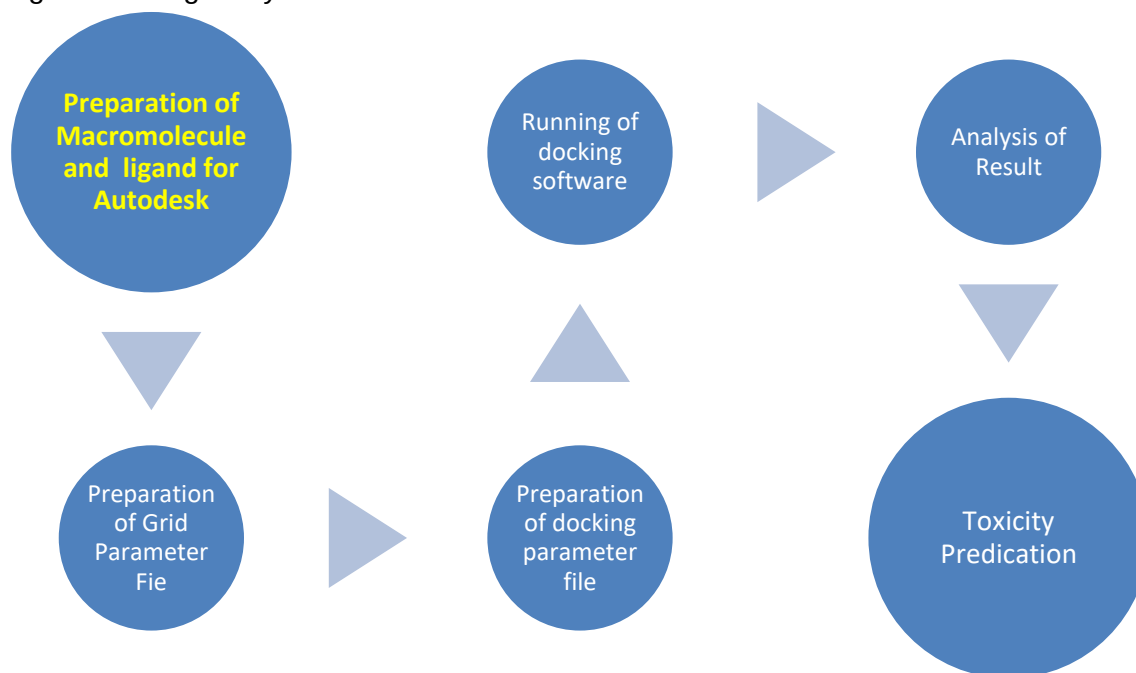
Reverse pharmacognosy

A new concept introduced in pharmacognosy is "reverse pharmacognosy" which involves the discovery of new biological agents. Targets were derived from similar chemicals and finally the source of biological chemicals was found in them [22]. The various steps of herbal healing are as follows:

Structural database for natural compounds

An independent resource is accessible in commercial libraries. Organized databases are often referred to as virtual chemical databases (VCDBs). For instance, CONCORD holds over 100,000 lead fragment models along with their 3D coordinates. The virtual examination of compounds is conducted through various chemical reactions. Establishing the structure of the target enzyme can be approached in two ways [23]: Experimental techniques include X-ray crystallography, nuclear magnetic resonance spectroscopy, etc. There are numerous homologous model software available in the market, such as Raptor X, Mod Pipe, Biskit, TASSER-Lite, Pro Model, LOMETS, and more.

Fig. 7. Docking study of macromolecules



Design of inhibitor molecules: There are two methods of virtual screening: screening based on ligand strength, refers to physical and chemical (one-dimensional data) and pharmacophore (3-dimensional data) which are structure-activity relationship (QSAR) tools. Docking with various software such as AutoDock, DOCK, DOT, FADE etc. involves the following steps: Recent advances in clinical healing have opened the door to new models in science, including the development of various computer-aided methods including herbal knowledge and an overview of taxonomy, phylogeny and phytochemicals of bioactive compounds. For example; Ethnopharmacology Database (ETPHDB) contains information on plant families, genera, species,

names and synonyms. The development of such software accelerates herbal drug discovery. By using molecular docking studies, Soni et al. Rutin (flavonoid) and COX-2.

Docking studies confirm that the main interactions between COX-2 inhibitors and rutin are hydrogen bonds and van der Waals communication. The natural plant flavonoid rutin reviewed above has been identified as a ligand and its COX-2 inhibitory effect activity was computerized with the help of docking stations.[24]

DNA Barcoding

It helps in identifying raw materials. A region of the gene consisting of approximately 600 base pairs was sequenced and used as a barcode [25].

Biosynthesis and regulation of bioactive compounds

Plants yield secondary metabolites through treatment processes. Therefore, the caliber of raw materials primarily hinges on the existence and concentration of these compounds. Molecular pharmacognosy research focuses on the study of genes/genomes responsible for the production and regulation of plant products. It also includes the use of genetics to increase the level of bioactive substances [26]. Physiological changes such as manganese restriction increase the levels of vitamin C in black yeast.

Preservation of Germplasm resources

Germplasm resources are alternatively referred to as genetic assets. Germplasm consists of various genetic materials produced from reproductive material. These resources will be used in the future to select and propagate new plants with high yields of secondary metabolites [27]. Collection, grouping, storage and analysis of bacterial resources are important aspects of research on herbal medicinal products [28]

Natural product biosynthesis diversity

The study of natural product biosynthetic pathways at the molecular level opens the door to the discovery of new drugs. A recent research review demonstrates how conservation of enzymatic systems is used in the construction of many types of biosynthetics. This knowledge will be linked to the next generation of natural product discovery using functional genomics. Chalcone synthase, a plant natural polyketide synthase, has been characterized at the molecular level [29].

Genomics, Proteomics and Metabolomics

The examination of the genome's structure and function falls within the realm of genomics. This field also encompasses subfields such as structural genomics, functional genomics, and comparative genomics. The investigation of the proteasome includes studying the complete array of proteins generated by the cell. Moreover, employing genome sequencing to assess a cell's, tissue's, or organism's capability for small molecule synthesis is categorized under metabolomics [30]. This is also described as "the analysis of chemical signatures produced by distinct cellular processes." Natural product metabolomics is an important basis for studying the relationship between the composition of complex and diverse plant-derived chemical compounds and their

biological effects. Plant metabolism begins with the analysis of as many bioactive fragments as possible in the product. It also helps to look for acids, percentages and ingredients. Individual plant marker compounds, for example, the study of metabolites in Ginkgo biloba leaves and the effect of harvest time (sunrise and sunset) on flavonoid content [31]

Application of molecular pharmacognosy

Pharmacognosy is currently a trending subject in the field, while the exploration of molecular mechanisms serves as the foundational theory of molecular biology. Molecular pharmacognosy is a research area that will not cause intense development concerns in the future. Molecular pharmacognosy has become a new intermediate discipline. With the help of molecular pharmacognosy methods and technology, difficult problems such as identification of medicinal products, etiology and prevention of harmful plants have been solved. Therefore, molecular pharmacognosy will bring new methods and perspectives to the treatment of pharmacognosy.

Nanotechnology

Research on plants and natural products continues worldwide. The development of herbs for drug delivery is being done in many organizations, both in the early and clinical stages. All that needs to be done is to develop better methods that will allow these drugs to be delivered to specific areas and throughout the body in doses that do not interfere with current treatments. Something that will reduce side effects such as toxicity and allergic reactions, while also supporting the patient from within, would be ideal. In the coming years, the idea of utilizing herbal nanoparticles for the delivery of cancer drugs could be adopted by various research teams and yield promising outcomes. There are many successful examples with empirical evidence in the direction of nanotechnology research around us. Herbs are also a rich source of nutrients containing antioxidants and components that can be used in nutritious foods. The combined research of "herbal" medicine and new methods of modern drug delivery (e.g. "nanotechnology") has led to the development of beauty medicine that will improve people's health in the future. The effective and efficient use of natural and herbal products with nanocarriers is expected to increase the delivery efficiency of existing drugs.

Research on plants and natural products is ongoing worldwide. The development of herbs for drug delivery is being done in many organizations, both in the early and clinical stages. All that needs to be done is to develop better methods for delivering these drugs to specific areas of the body and in a way that does not interfere with existing treatments. Something that will reduce side effects such as toxicity and allergic reactions, while also supporting the patient from within, would be ideal. In the coming years, the idea of utilizing herbal nanoparticles for the delivery of cancer drugs could be adopted by various research teams and yield promising outcomes. Therefore, the use of "plants" in nanocarriers will make it possible to treat many diseases and provide health. There are many successful examples with empirical evidence in our environment in line with nanotechnology research. Herbs are also a rich source of nutrients containing antioxidants and components that can be used in nutritious foods. The combined research of "herbal" medicine and new methods of modern drug delivery (e.g. "nanotechnology") has led to the development of beauty medicine that will improve people's health in the future. The effective and efficient use of

natural and herbal products with nanocarriers is expected to increase the delivery efficiency of existing drugs

Conclusion

As we enter the new millennium of the 21st century, pharmacognosy can be considered a discipline. Sky's overall supply stands at a record peak. Over the past ten years, the advantages of medicinal plants have been validated. This is happening there are Physicians, such as pharmacy and medicine, have increasingly complied with the decision, considering herbal medicines (plant medicines) as a negative treatment. The latest innovation in the field of pharmacognosy is molecular pharmacognosy. This happened with the development of molecular biology. Modern molecular biology technology is rapidly developing in the production of components of medicinal products. However, each method has some limitations such as accuracy, efficiency and cost. Therefore, these limitations need to be overcome. In addition, successful studies in the field of molecular pharmacognosy are recommended in DNA fingerprint analysis, DNA analysis of plant data, investigation of phylogenetic relationships and recovery of damaged plants. Resources are available for future reference. This new discipline has been brought together Relationships between medicine and various branches of science, such as Molecular biology, biotechnology, chemical biology, structure Biology, proteomics, genomics, metabolomics and bioinformatics.

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