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## Herbs, microbes, magic molecules

The Indian Institute of Integrative Medicine, Jammu, has been at the forefront of the process of discovery of drugs in the battle against diseases



The human body can get a variety of diseases. There is an unending competition between drug and disease. New diseases may crop up. New drugs will have to be found to treat them. Better and more effective drugs for treating known diseases are often discovered. Efforts for drug discovery can come to fruition only after long-

drawn-out experiments, investigations, trials, different phases of clinical studies, tests of toxicology, permission of drug administration authorities, and legal formalities for approval.

Target identification and validation and lead optimisation are some of the interim stages of drug development. Follow-up studies are essential. The entire process is expensive. But the results will prove to be a boon for humanity. Little wonder, the pharmaceutical industry enjoys a multi-billion dollar turnover at the global level.

Contributions are required from experts in different disciplines such as biology, human physiology, genetics, chemistry, microbiology, pharmacology, toxicology, biotechnology, physics, and law, for developing a drug.

Practically every medical system uses plant-based drugs. India has a rich tradition in using herbs for drug preparation. Modern styles of drug presentation have emerged, partly elbowing out some of the old formulations. We have a great lot to do in drug discovery, using our natural resources, including plants and trees.

An institution that has been doing committed service in this area is the Indian Institute of Integrative Medicine (IIIM), Canal Road, Jammu-180 001, Web: [www.iiim.res.in](http://www.iiim.res.in). Its primary focus of research is on drug discovery from natural products, such as medicinal plants and microbial species.

The IIM was established in 1941 as the Drug Research Laboratory of Jammu and Kashmir. It was taken over by the Council of Scientific and Industrial Research in 1957. It assumed its present name in 2005. It offers consultancy services to the drug industry and related administration.

## **Research areas**

Let us look at the work being carried out by its different research groups.

Natural products chemistry (plants): The expertise of the institute in the area of developing herbal drugs, based on traditional systems of healthcare and validated by modern systems, has to be fully utilised.

The areas of research focus include isolation of new bioactive molecules from natural sources and development of standardised herbal products as new drug candidates or positive health promoters.

Natural products chemistry (microbes): Antibiotics are well-known natural microbial product drugs. Though there are thousands of microbial secondary metabolites, only a small percentage of them have been developed as natural product drugs. There are bright prospects for research in this area. This division focuses on isolation and characterisation of novel bioactive molecules, and bio-evaluation of pure molecules

Medicinal chemistry division: The areas of research cover drug discovery, chemical biology, carbohydrate, protein, peptide, and bio-conjugate chemistry, development of novel synthetic methodologies, and improvement of existing drugs by molecular modifications, design and synthesis of new medicinal agents, development of new concepts for the design of selectively active ligands, and improvement of existing drugs by molecular modifications, and novel drugs for treating cancer, inflammation, obesity, and tuberculosis.

Bio-organic chemistry division: Natural products, biocatalysis, organocatalysis, glyco-chemistry, and organic synthesis. Natural plant biodiversity specifically related to medicinal plants used in traditional medicine. Drug development. Rational drug design using molecular modelling.

Analytical chemistry division: Pharmacokinetic and ADME (absorption, distribution, metabolism, and excretion) studies of structurally and therapeutically different drugs and their validation. Isolation and characterisation of natural products from medicinal and aromatic plants used in herbal preparations.

Chemical engineering division: Process development and scale-up of laboratory processes on pilot plant. Extraction processes usually carried out on medicinal plants are scaled up from 100/500-g

laboratory-scale to 15-20-kg pilot plant scale processes. Then their process parameters are optimised to maximise the yield of these extractions.

Plant biotechnology division: It has a rich storehouse of medicinal, aromatic, and other economic plants. This division, taking advantage of the rich biodiversity, uses cutting-edge molecular biology and genetic tools to engineer metabolic pathways and produce elite varieties with desired chemoprofiles.

Biodiversity and applied botany division: Studies on high-altitude biology addressing botanical curiosities for sustainable utilisation of critically endangered medicinal plants. Gene-pool characterisation and development of new elite varieties. Elite genotype designing in medicinal plants using conventional and molecular breeding approaches.

Genetics resources and agrotechnology: Development of agrotechniques for propagation, multiplication, and supply of elite planting material of medicinal and aromatic plants. Maintenance of germplasm of plants to be used for crop improvement and molecular and chemical characterisation studies. Commercialisation of elite varieties of medicinal and aromatic plants.

Fermentation technology division: Microbial biodiversity research leading to the production of novel bioactive products, biocatalysts, and bio-transformed products. Entophytes isolation and characterisation from selected plants for high-value products. This division is well equipped with latest fermentors and downstream processing facilities.

Microbial biotechnology division: Molecular and biochemical characterisation of bioactive molecules and enzymes from cultivable micro-organisms. Development of new fungal expression systems. Diagnostic microbiology. Development of molecular methods for rapid detection of food-borne and clinical pathogens.

Clinical microbiology division: Regulation of *M. tuberculosis* gene expression. Anti-infective research with reference to identification of plant-derived pharmacophores. Oral microbiology.

Systems biology division: Development of *Drosophila* models for neurological disorders. Identification of differential phosphorylation states at complete proteome level in various cancers as compared to normal cells.

Cancer pharmacology division: Anti-cancer drug discovery. Development of anti-cancer therapeutics from plants, fungi, bacteria, and semi-synthetic and synthetic molecules.

Diabetes pharmacology division: Understanding the causes of Type 2 diabetes mellitus and investigating therapies. Collaborative research between scientists and physicians — “bench-to-bedside”

model. Pre-clinical development of herbal-based extracts and molecules of synthetic origin for type 2 with focus on insulin sensitisation.

Inflammation pharmacology division: Development of new anti-inflammatory, anti-arthritic and immunomodulatory therapeutics, devoid of side effects. Development of new adjuvants for vaccines. (Adjuvant is an agent that may stimulate the immune system and increase the response to a vaccine). Toxicity study: acute, sub-acute, sub-chronic, and chronic toxicity.

PK-PD and toxicology division: The main focus of the pharmacokinetic and pharmacodynamic division is to provide support to the drug discovery programme in the areas of pharmacokinetics, ADME, and toxicology. Skin photobiology, pharmacology, and UV-irradiation-induced photo-ageing in human skin cells and its prevention by products from natural and synthetic sources are other areas.

Formulations and drug-delivery systems division: Formulation development of drugs from natural products. Formulation development and novel drug delivery systems.

Quality control and quality assurance and CMC: Analytical chemistry, food chemistry, quality evaluation of natural and herbal products, and fingerprinting of herbal formulations. Analysis of trace elements, heavy metals, aflatoxins, and pesticides in all products for human consumption.

Discovery informatics: Molecular docking, QSAR studies, and 3-D structure prediction using homology modelling and threading techniques. Studies related to ligand-receptor interaction mechanisms for targets such as anti-cancer, anti-inflammatory, and anti-bacterial areas (QSAR: Quantitative structure-activity relationships).

### **Srinagar unit**

It carries out establishment of plant germbanks of high-altitude medicinal and aromatic plants, as also commercialisation of bioactive molecules from medicinal and aromatic plants and fungi.