FUTURISTIC TRENDS IN MEDICINAL PLANT RESEARCH

Abstract

Traditional medicine and treatment with herbs are nothing new to humanity; they have been used for several thousand years and are still used. Due to its numerous advantages, both developed and emerging nations are currently concentrating on treatments based on herbal medicine. India is referred to as the "the land of herbs," and the Ayurvedic traditional medical system there was also built on the use of herbs and other therapeutic plants. Medicinal plants with a history of medicinal use are commonly found in India. The localization of highly advanced technologies and the globalization of local knowledge regarding the use of indigenous medicinal herbs by traditional healers have sped up the growth of the herbal industry. Herbal medicine is often referred to as botanical or phytomedicine. 80% of the world's population relies on traditional herbal medicine for their main healthcare requirements, according to a World Health Organisation study report. Herbal therapy has seen a discernible increase in demand and application recently, heralding a "renaissance" of the field. Because of its efficacy, safety, and lack of harmful side effects, alternative medicine is actually growing in popularity in industrialised countries. When administered, herbal medications are more readily tolerated by patients and have a lengthy history of use. The commercialization of herbal medicine was aided by the widespread use of these formulations, which emerged from academic research and modern technological developments.

Keywords: The localization of highly advanced technologies and the globalization.

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I. INTRODUCTION

Medicines have been made from natural herbs since long before history was written. The selection of plants with the appropriate medical qualities has been restricted over time. Scientists have discovered that people employ comparable plant species for similar medical uses in the same region and perhaps the entire world. Other fields also make use of therapeutic herbs to maintain health [1], [2]. Natural compounds have also been used for aesthetic and fitness routines across a wide range of human civilizations. Herbal remedies are effective primarily because they contain chemical components that interact favourably with the body or immune systems of humans to fight sickness [3], [4]. Only after the development of the current scientific approach and the fields of biological and chemical science did people start to comprehend how herbal treatments function. Scientists started looking at the chemical makeup of conventional herbal remedies as contemporary sciences advanced. The creation of modern medications was influenced by this study and contemporary understanding of human biology [5][6].

Natural herbal remedies are significant complementary and alternative therapies in the globe and have been essential to human growth. Over the years, the competitive edge of utilizing herbal medicines has steadily switched from the use of synthetic to herbal medicine, in a process that may be referred to as a "Returning to Nature [7], [8]. " It is well known that both India's rural and urban populations favour ayurvedic herbal remedies. The growing number of health risks connected to the uncontrolled use of contemporary allopathic therapies and medications has rekindled interest in herbal-based medicine. Numerous research papers and publications on a wide range of trends and problems related to the use of herbal products have been written in response to the increasing interest in herbal medicine [9]–[11].

Table 1: List of Current Traditional Medical Systems in Various Nations.

Country	Traditional System of Medicine
India	Ayurveda
China	Traditional Chiese System of medicine
Japan	Kampo
Korea	Hanbang
Pakistan	Indusynunic
Middle East	Islamic, Unani
Europe	Aromatherapy, herbalism
USA, Australia	Western herbal medicine

II. CHALLENGES

1. **Regulations' Effects on Herbal Medication Status and Safety:** It has been noted that the most of issues with the use of herbal medicines are brought about by some governments designating these products as foods or dietary supplements. Both national medical specialists and the general public began to place a high priority on the safety of conventional and herbal treatments. A medicinal herb may be labelled as a meal, a

therapeutic food, a nutraceutical, or a herbal remedy depending on the definition and laws that apply to food and herbal preparations in various countries. As a result, including herbal medications under national drug regulations is problematic and confusing for both customers and patients.[12], [13]

2. **Issues with Herbal Drug-Allopathic Drug Interaction:** Numerous active phytoconstituents with varying pharmacology, individual metabolisms, and binding properties can be found in a variety of herbs. These pharmaceuticals may also interact with allopathic medicines in pharmacokinetic or pharmacodynamic ways. Herbal pharmaceuticals interact more frequently with allopathic medicines with a limited therapeutic window.[14]

3. **Issues with Quality Monitoring of Herbal Medicines:** The quality of the raw materials used to create phytochemicals depends on fundamental (genetic) components as well as environmental factors, excellent agricultural practices, and good collecting techniques, which include crop selection, cultivation, and collection methods. It is challenging to carry out quality control of raw ingredients because of the combination of all these concerns. Due to the different difficulties in confirming the existence of all the herbs or raw materials, the quality of the finished herbal product is frequently a significant problem, especially with mixed herbal products. As a result, there are generally more requirements and processes for quality control of finished goods than there is for other medications.[15], [16]

4. **Difficulties with Ensuring the Safety of Herbals:** Research has been done to monitor the positive effects as well as possible adverse reactions, as well as to give scientific confirmation of the beneficial effects and safety of medicinal herbs, as consumption of herbal products has significantly increased over the past several decades. Evaluation of the safety of medicinal plants has become a top priority for consumers, regulatory advisers, and healthcare professionals because adverse action analysis for herbal medications is far more complicated than it is for conventional pharmaceuticals. Additionally, because herbal plant manufacturers sometimes overlook or undervalue the significance of taxonomy and documentation, the authenticity and collecting of herbal material for therapeutic purposes presents a unique problem.[17]

5. **Clinical Research Challenges for Herbal Medicines:** Before submitting a newly developed medication for major phase III trials, it is important to address the many difficulties that come with studying herbal medicines. These difficulties include those that pertain to the study's budget, ethics, quality control, plan, and regulatory requirements. In contrast, it is challenging to maintain double-blindness when it comes to herbal preparations because this healing procedure involves a diverse therapy strategy that includes lifestyle, listening, counselling, explaining, and nutritional suggestions in addition to proposing herbal medicines.[18]

6. **Government Initiations:** The Government of India has revised the Drugs and Cosmetics Act, 1940 & Rules 1945 to incorporate Phytopharmaceutical medications as a new category, taking a cue from the worldwide trends and opportunities in plant-based therapies. In order to assess and approve the commercialization of a herbal medication on par with synthetic, chemical moieties, this gazette notification establishes regulatory

regulations for phytopharmaceuticals and regulatory submission requirements for scientific data on quality, safety, and efficacy.

According to the new regulations, a phytopharmaceutical drug is a purified and standardised fraction with a defined minimum four bioactive or phytochemical compounds (qualitatively and quantitatively assessed) from an extract of a medicinal plant or its part, for internal or external use by humans or animals for the diagnosis, treatment, mitigation, or prevention of any disease or disorder; parenteral administration is not included in this definition.[19]

The new phytopharmaceuticals regulation allows for the development of drugs using cutting-edge methods like solvent extraction, fractionation, potentiating steps, and modern formulation development, among others. The regulation for this class of drugs is on par with regulations in the USA, China, and other nations and includes scientific evaluation and data generation. This new law has rekindled hope for fresh discoveries and the scientific development of new pharmaceuticals derived from botanicals, and it will contribute to the widespread acceptance of the use of herbal remedies by the modern medical profession.[20], [21]

The Council of Scientific and Industrial Research (CSIR) has a natural advantage in the development of phytopharmaceutical drugs. As a result, the CSIR Phytopharmaceutical Mission has been developed and is currently being put into operation. Through desirable interventions in the areas of agriculture, processing, and drug research and development, the CSIR Phytopharmaceutical Mission is intended to bring about revolutionary change in the medicinal plant sector and fuel the expansion of the phytopharmaceutical industry and rural employment. Additionally, the production of phytopharmaceutical products for both domestic and international markets will heavily rely on this mission.

7. **Plant-Based Drug Discovery: Ethnopharmacological Approach:** The need for effective, dependable, and less hazardous treatments for a variety of illnesses makes drug discovery essential. The foundation of pharmaceutical industries' drug discovery investigations is medical research. Before the registration of a new drug, a compound must be thoroughly researched. The candidate plant material can be chosen at random or identified using databases created for this purpose as part of the screening processes used to research the effective plant-based molecule. However, these techniques are costly, time-consuming, and low-productive processes that frequently fail. The therapeutic innovation is now being saved by high throughput screening techniques, genomics, and combinatorial chemical technologies.[7], [22]

   In recent years, awareness of conceptual and methodological norms in this sector has grown. In fact, rational phytotherapy research differs from medical herbalism, which employs an empirical approach, in that it focuses on using plant-based products to cure a variety of ailments. In developing Asian, South American, and African nations where there is some familiarity with the conventional medical system, ethnopharmacology research methodology is frequently used.[23], [24]

8. **Importance of Medicinal Plants in Drug Discovery:** Many techniques, including as isolation from plants and other natural sources, have been used to obtain molecules for drug discovery. Despite the increasing interest by pharmaceutical corporations and

funding organisations in molecular modelling, combinatorial chemistry, and other synthetic chemistry approaches, medicinal plants continue to be a significant source of new medications, new drug leads, and new chemical entities (NCEs).[25]

Drugs generated from medicinal plants can be used as both new drugs in and of themselves as well as drug leads for medicinal and synthetic chemists to optimise. Drug leads can be found in existing compounds with novel biological activity even when new chemical structures are not discovered during the drug development process for medicinal plants. Since the human genome was sequenced, thousands of additional molecular targets have been shown to be crucial in a number of disorders.[26], [27]

III. FUTURE TRENDS IN MEDICINAL PLANT RESEARCH

1. **Advanced Technologies for Extraction and Characterization:** The extraction and characterisation of bioactive chemicals from therapeutic and aromatic plants are being studied using novel and cutting-edge technology. This covers the application of supercritical fluid extraction, microwave-assisted extraction, and methods based on nanotechnology.[28]

2. **Functional Genomics and Metabolomics:** The studies of functional genomics and metabolomics, which are only starting out, provide fresh perspectives on the molecular processes that underlie the therapeutic effects of medicinal plants. These methods can aid in the discovery of new bioactive substances and the comprehension of their mechanisms of action.[29]

3. **Plant-Microbe Interactions:** Research on the interactions between microorganisms and medicinal plants is crucial in order to comprehend how these interactions affect plant development, growth, and defence systems. The identification of new species of medicinal plants and the creation of cutting-edge plant-based medicines are both possible outcomes of this field of study.[30]

4. **Pharmacological and Toxicological Studies:** In order to evaluate the effectiveness and safety of medicinal and aromatic plants, researchers are undertaking increasingly thorough pharmacological and toxicological tests. To assess the bioactivity and possible toxicity of plant extracts and isolated chemicals, this includes the use of in vitro and in vivo models.[31]

5. **Sustainable Cultivation and Production:** Given their importance to the environment and economy, medicinal and aromatic plant cultivation and production are becoming more and more vital. Researchers are looking into novel and creative methods of growing these plants, such as agroforestry, vertical farming, and hydroponics.[32], [33]

6. **Application of Artificial Intelligence and Machine Learning:** In order to forecast the therapeutic characteristics of plant extracts and chemicals, artificial intelligence and machine learning approaches are being applied to the study of medicinal and aromatic plants. Additionally, these procedures can aid in the discovery of novel bioactive substances and the enhancement of extraction processes.[34]

In a nutshell, the prospects of research on aromatic and medicinal plants is bright because it will make use of cutting-edge technologies, multidisciplinary strategies, and sustainable practices that may result in the development of novel treatments and more potent and secure plant-based medications.

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