WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

The Evolution of Herbal Medicine from Traditional to Modern Therapeutics

Yaramapu. Rinitha Reddy[1], Dr. Y. Prapurna Chandraph.D[2], K. Kavyasudha M.Pham P.Cology[3]

[1*] Pursuing Bachelor of Pharmacy at Rathnam Institute of Pharmacy, Pidathapolur, Nellore.

[2] Principal of Rathnam Institute of Pharmacy, Pidathapolur, Nellore. Ph.D. in Pharmacology, KLE University, Belgaum.

[3]Faculty- Associate Professor of Pharmacology, Rathnam Institute of Pharmacy, Pidathapolur, Nellore. M.Pharm. in Pharmacology, Sree Venkateshwara University, Tirupati.

ABSTRACT:

Herbal medicine is one of the oldest and most effective ways to heal. It has been around for a long time in human history and culture. People have been using medicinal plants for more than 60,000 years, and they come from many different cultures, including Egypt, China, India, and Greece. Ayurveda and Traditional Chinese Medicine (TCM) are examples of traditional healthcare systems that looked at the whole person and how they fit into their environment. These old systems thought that whole plants worked better together than isolated compounds. They passed down this knowledge through oral traditions and folk medicine. The shift from herbal medicine as an empirical practice to scientifically validated therapeutics sped up in the 19th century with the extraction of active compounds like alkaloids and glycosides. This brought traditional remedies into modern pharmacology. Recent advancements in phytochemistry, molecular biology, and analytical techniques have enabled precise characterization, quality control, and standardization of herbal products, ensuring their safety and efficacy. Evidence-based phytomedicines are widely accepted today and are becoming more common in mainstream medicine. You can use them instead of or in addition to synthetic drugs. In conclusion, herbal medicine embodies a dynamic synthesis of ancient wisdom and modern science.

Keywords: Herbal medicine, Traditional medicine, Modern therapeutics, Phytotherapy, Medicinal plants, Natural products, Evidence-based medicine.

1. INTRODUCTION:

Herbal medicine is one of the oldest ways to heal, and it has been used in traditional healthcare systems around the world for a long time. Ancient cultures like Egypt, China, India, and Greece have used medicinal plants for more than 60,000 years[1]. The Egyptian Ebers Papyrus and Ayurvedic texts are two examples of old pharmacopoeias that showed how hundreds of plants could be used to treat illnesses. A lot of these plants are still useful today. Oral traditions and folk medicine contributed to this heritage by emphasizing the significance of local biodiversity and plant synergy for health promotion, rather than focusing on isolated components. In the 19th century, it became much easier to combine with traditional pharmacology when active compounds like alkaloids and glycosides were separated. Modern phytochemical and molecular methods have made it possible to accurately identify, standardize, and check the quality of herbal formulations. This has made them safer and more effective. This integration has resulted in the development of evidence-based phytomedicine products, which are increasingly recognized as alternatives or supplements to synthetic pharmaceuticals. The World Health Organization says that almost 80% of people around the world use traditional herbal remedies as their main form of health care, especially in places where resources are limited[5].

Also, sustainability and conservation efforts are necessary to protect the biodiversity of medicinal plants that are at risk due to environmental damage and the effects of commercialization. This blend could help with global health issues like chronic diseases, antimicrobial resistance, and getting people to see a doctor [7].

The ongoing integration of historical knowledge with cutting-edge technology and regulatory frameworks promises to enhance healthcare outcomes worldwide, guaranteeing that herbal therapeutics remain vital for future health and well-being[8].

2. SCOPE OF HERBAL MEDICINE:

Herbal medicine, botanical medicine, or phytotherapy is the use of plants to keep people healthy and stop, treat, or cure diseases. They have been practicing for thousands of years, like Traditional Chinese Medicine (TCM) and Ayurveda, which focus on how all the body's systems work together. Herbal medicine employs entire plants or their components, such as leaves, roots, bark, flowers, and seeds, in various forms including decoctions, infusions, extracts, tinctures, powders, and topical applications[10]. People use it for everything from self-care and health practices in their communities to formal healthcare systems where evidence-based herbal therapies work with regular medicine. Additionally, many modern pharmaceuticals are derived from compounds originally isolated from medicinal plants, underscoring the critical role of herbal medicines in drug discovery and development.

Herbal medicine is a broad and changing field that includes many different kinds of treatments made from plants. It is a combination of traditional knowledge, scientific research, and clinical practice, and it is essential for healthcare systems globally[13].

3.HISTORICAL ROOTS OF HERBAL MEDICINE:

People have been using herbal medicine for the longest time. It comes from the first times people and plants interacted with each other[14]. People who lived before history thought that some plants could heal them and probably used them in rituals to stay healthy and alive. Ötzi the Iceman's preserved remains from more than 5,000 years ago show that people in prehistoric times had advanced knowledge of plants, as they used them to treat intestinal parasites. People in ancient Mesopotamia started writing down what they knew about herbal medicine more than 5,000 years ago. It was in Mesopotamia that civilization first started to grow. It used both observation and tradition to make the foundation of pharmacology. The ancient Egyptians set their medical practices apart by using plant-based treatments along with religious and magical rituals. Aloe vera, garlic, willow, and juniper are still common in natural medicine today, which shows that these old remedies still work well.

For more than 3,000 years, herbalism has been seen as the most important part of Traditional Chinese Medicine (TCM), which is a growing field in East Asia. TCM not only treats symptoms, but it also aims to restore systemic harmony through personalized herbal formulas, acupuncture, and dietary changes[18]. Ayurveda in India has been using herbal medicine as part of a whole health philosophy for at least 5,000 years. Ayurveda, which comes from ancient Indian texts like the Charaka Samhita and Sushruta Samhita, is all about keeping the body's doshas, or vital energies, in balance. It does this by using herbs to help the body work better and fight off infections[19]. Western botanical medicine was greatly influenced by scholars from Greece and Rome. Hippocrates, the father of medicine, was the first to use clinical observation and make a list of medicines made from plants.

Synthetic drugs were the most common type of medicine in the 19th and 20th centuries. However, herbal medicine stayed popular around the world, especially in non-Western cultures where it is still an important part of primary healthcare. In the late 20th century, phytochemical and pharmacological research validated numerous traditional remedies, resulting in a revival. Herbal products are part of modern integrative medicine, but it puts a lot of stress on quality, safety, and using methods that are based on evidence. The World Health Organization acknowledges the important role of traditional herbal medicine and advocates for sustainable practices to protect this important cultural and medical heritage[22-23]. The historical origins of herbal medicine constitute an evolutionary continuum spanning millennia, encompassing empirical discovery, cultural transmission, philosophical integration, and modern scientific validation[24].

4.PHYTOCHEMISTRY OF MEDICINAL PLANTS:

Phytochemistry, the study of the chemicals that plants make, is an important field of research for finding out more about how medicinal plants can help people. Plants make a lot of secondary metabolites, which are also called phytochemicals. These are bioactive chemicals. They are very important for plants' defense and how they interact with other living things in their environment[25]. Some of the most important types of compounds that give herbs their medicinal properties in traditional medicine around the world are alkaloids, flavonoids, phenolic compounds, terpenoids, tannins, saponins, glycosides, and steroids. This biochemical diversity is what gives medicinal plants a wide range of pharmacological effects, like being an antioxidant, anti-inflammatory, antimicrobial, anticancer, and cardioprotective agent[26]. Using phytochemicals to extract these compounds from the plant matrix is the first important step in separating them for analysis. Traditional methods of extracting something include maceration, infusion, digestion, decoction, and percolation.

Alkaloids are very important in medicine because they can help with a lot of different things, like pain relief, cancer treatment, malaria treatment, and fighting germs. Morphine and quinine are two drugs that come from plants. They are both made from plant alkaloids. Flavonoids and phenolic acids are powerful antioxidants that help lower oxidative stress. This stress is linked to chronic diseases like diabetes and heart problems. Terpenoids, including monoterpenes and sesquiterpenes, demonstrate immunomodulatory and cytotoxic effects, with compounds such as paclitaxel acting as effective anticancer agents[27].

Phytochemistry facilitates the transition from herbal folklore to evidence-based therapeutics by integrating traditional knowledge with advanced extraction, analytical, and computational techniques. [28].

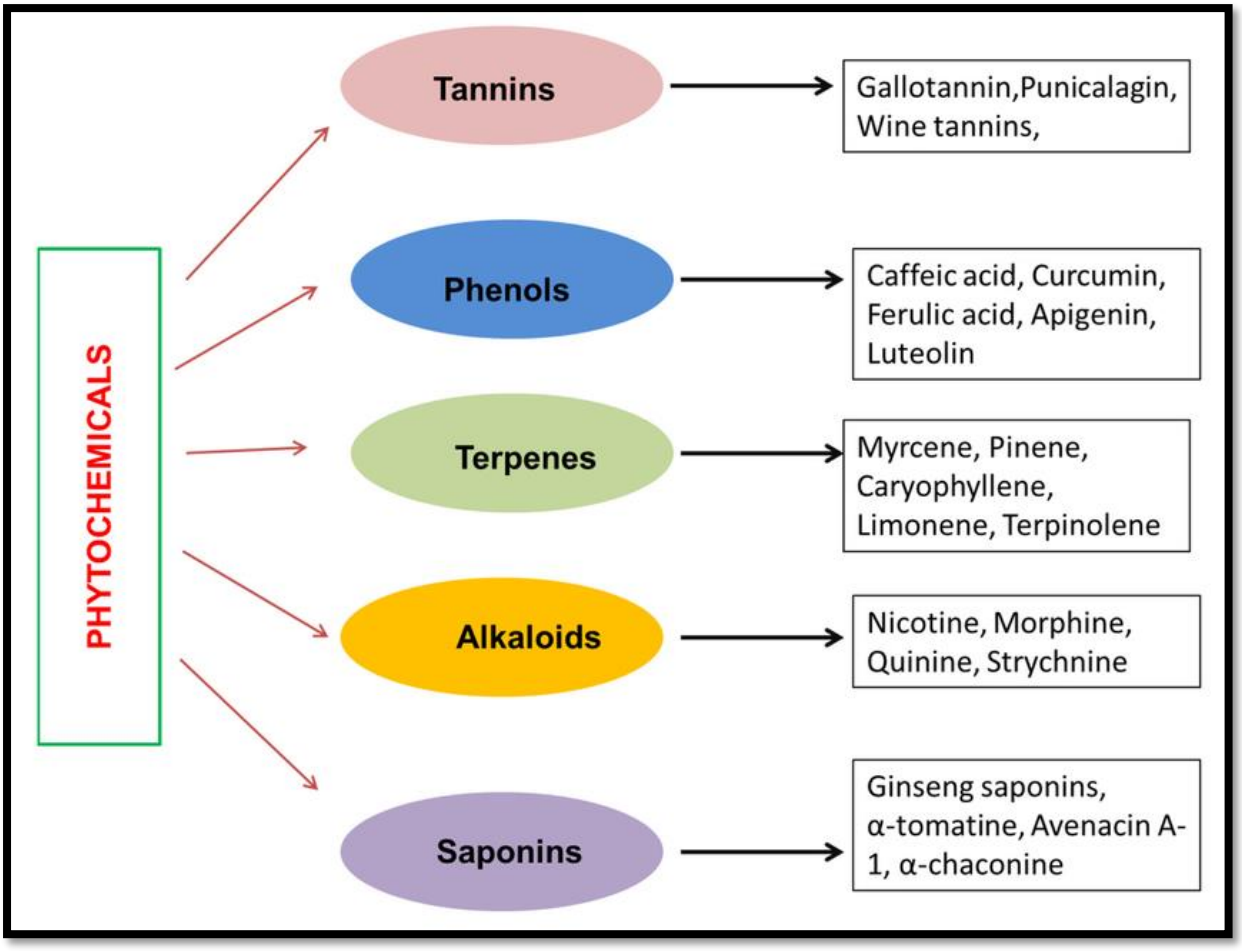

Figure 1: Major Classes Of Phytochemicals in Medicinal Plants

Smith J, Kumar P, Rahman A. Phytochemical constituents of medicinal plants: A review. J Ethnopharmacol. 2022;280:114436.

5.HERBAL MEDICINE IN THE AGE OF MODERN PHARMACOLOGY:

Herbal medicine is making a comeback as it becomes more connected to modern pharmacological science, turning old plant-based treatments into proven medical treatments. This integration is speeding up the making of herbal medicines that are safer, more effective, and more standardized, and that solve modern healthcare problems while keeping traditional knowledge alive[29]. One of the main reasons is that analytical methods have gotten better, which makes it possible to fully describe bioactive phytochemicals. Nuclear magnetic resonance spectroscopy, mass spectrometry, and high-performance liquid chromatography (HPLC) can be used to chemically sort and measure active herbal ingredients [30]. Recent reviews summarize more than a thousand clinical trials of herbal medicine, mostly done in Asia, that looked at a wide range of conditions, from respiratory infections to psychosomatic disorders.

The therapeutic benefits demonstrated by various herbs in clinical settings support their adjunctive use in the management of chronic conditions, such as diabetes, cardiovascular diseases, arthritis, and mood disorders. For instance, research indicates that Ayurvedic formulations utilizing standardized herbal extracts are effective in treating ischemic heart disease, obesity, and asthma. Further advanced research is required to validate specific applications and effectively promote the incorporation of standards.

Safety is still the most important thing because herbal medicines can change how cytochrome P450 enzyme systems work and interact with regular medicines, which can have bad effects. Integrative pharmacology research elucidates these interactions, informing clinical decisions and improving patient safety[32]. Nanotechnology is changing phytomedicine by making new delivery systems that make herbal bioactives more bioavailable and more specific to their targets. Nanoformulations assist phytochemicals that exhibit poor solubility or stability, thereby enhancing therapeutic efficacy and reducing adverse effects[33]. The World Health Organization says that herbal products should be used and regulated based on evidence to make sure they are safe and everyone can get them, especially in places with few resources. When regulatory bodies work together, it makes it easier for countries to work together, which helps make and sell high-quality herbal medicines[34].

Through strict chemical characterization, clinical validation, safety profiling, and new delivery technologies, phytomedicine is becoming an important part of global healthcare.

For hundreds of years, people all over the world have used herbal remedies as natural medicines. But because they are becoming more popular and accepted in traditional medicine, concerns about their safety and toxicity have come under more scrutiny[36]. This scientific requirement includes checking for toxins, making sure the quality is good, keeping an eye on drugs, and making sure that everyone follows the same rules. One of the biggest safety concerns with herbal products is that they are complicated and have many bioactive compounds that work in different ways and can be harmful in different ways[37]. Toxicological evaluations of herbal medicines encompass multiple stages, including in vitro assays (cytotoxicity, genotoxicity), in vivo animal models assessing acute, sub-chronic, and chronic toxicities, and human clinical trials monitoring adverse effects. Hepatotoxicity, nephrotoxicity, and neurotoxicity are commonly investigated endpoints owing to the liver, kidneys, and nervous system's roles in metabolism and their vulnerability to toxic substances.

Another safety concern is microbial contamination, especially with powdered herbs. Adhering to proper drying, storage, and manufacturing hygiene protocols can inhibit microbial proliferation and toxin production, thereby safeguarding consumers from infections and mycotoxicosis [39]. Recent scientific trends underscore the importance of employing comprehensive toxicity profiling that amalgamates preclinical studies, clinical observations, advanced analytical chemistry, and computational toxicology to predict and mitigate risks [40]. .

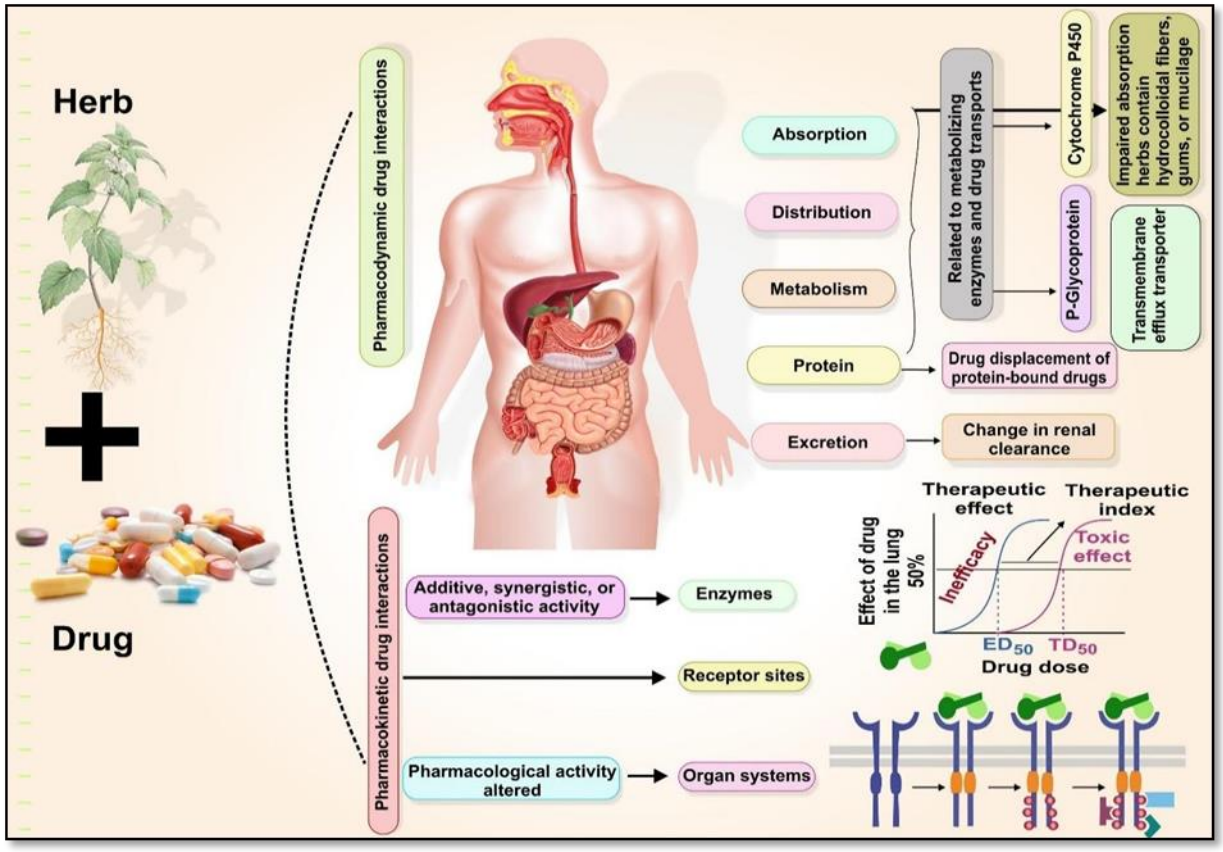

Figure 2: Safety, Efficacy and Bioactivity of Herbal medicine

Smith J, Patel R, Khan M. Safety, efficacy, and bioactivity of herbal medicines: An overview of herb–drug interactions. J Ethnopharmacol. 2023;310:116445.

7.QUALITY CONTROL AND STANDARDIZATION:

It is very important to set standards and control the quality of herbal medicines so that they are safe, effective, and consistent. Herbal products are not the same as regular medicines because they contain a lot of different bioactive compounds. The kinds of plants, how they were grown, when they were picked, and how they were processed can all change these compounds[41]. To keep people's trust and the effectiveness of treatments, strict quality control rules and standardization procedures must be made and followed. Things like shape, size, color, texture, smell, and taste are all taken into account when doing macroscopic evaluations. Microscopic evaluations, on the other hand, look at the properties of cells and powders, often using advanced microscopy techniques like scanning electron microscopy (SEM) [42]. You can look at the physical properties of raw materials, such as their moisture content, total ash, acid-insoluble ash, extractive values, and foreign matter, to see how well they will work and how well they will be processed[43].

The World Health Organization (WHO) has published detailed instructions on how to keep the quality of medicinal plant materials under control. These rules cover everything from how to tell if something is real to how to grow it, how to make it, how to standardize chemicals and biological materials, how to test for contaminants, and how to label it [44].

Modern herbal medicine relies heavily on quality control and standardization to guarantee that its products are reliable, safe, and consistent[45].

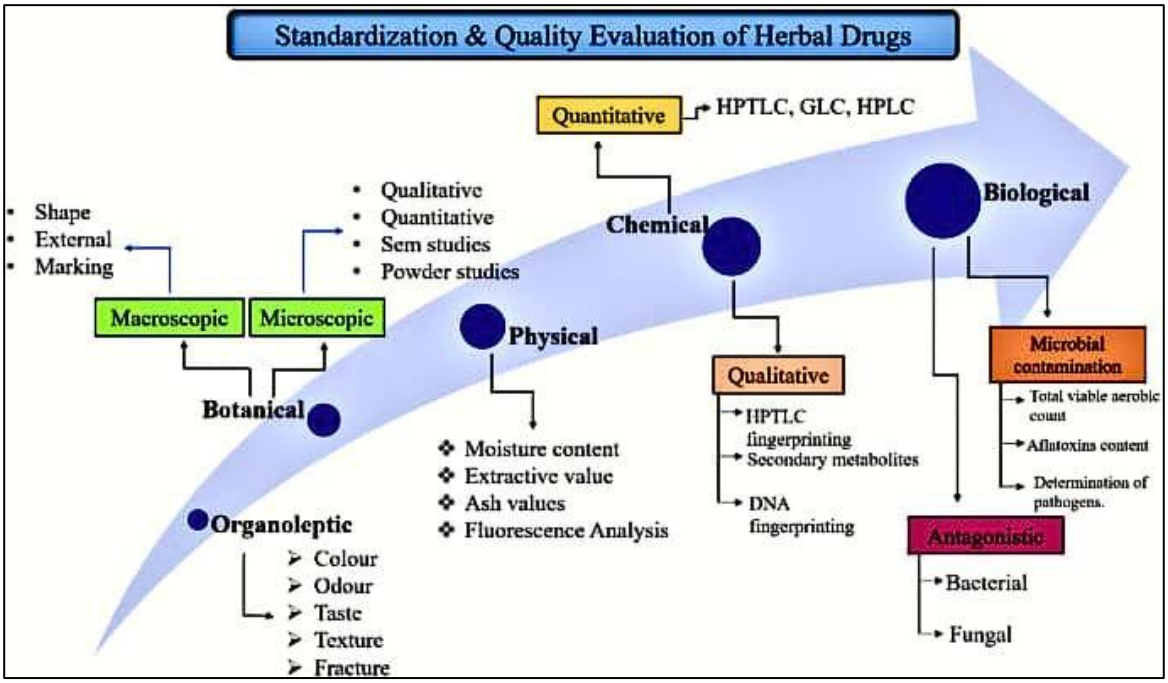

Figure 3: Quality Control And Standardization

Kunle OF, Egharevba HO, Ahmadu PO. Standardization of herbal medicines—A review. Int J Biodivers Conserv. 2012;4(3):101–12.

8.GLOBALIZATION AND COMMERCIALIZATION OF HERBAL MEDICINE:

The globalization and commercialization of herbal medicine indicate substantial changes in the perception, production, and distribution of traditional botanical therapies worldwide. The herbal medicine market has grown a lot because more and more people are choosing natural and holistic health methods. In the modern pharmaceutical and wellness industries, ancient remedies are very popular right now[46]. This growth is being driven by more chronic illnesses, worries about the environment, customers' desire for natural products, more clinical research, and more money going into the wellness industry[47]. The long history of using herbal medicines in different cultures, like Ayurveda and Traditional Chinese Medicine (TCM), has greatly increased the demand for them around the world[48].

Network pharmacology techniques show that herbal medicines can work on more than one target at the same time. This makes them better than synthetic drugs that only work on one target and makes them good for treating long-term and complicated illnesses that need more than one medication. New technologies for extraction, formulation, and delivery are also making the process of getting products to market faster. Herbal medicine has gone from being a local tradition to a big global industry that is linked to science, culture, the economy, and policy because of globalization and commercialization. [51].

9.TECHNOLOGICAL ADVANCES DRIVING MODERNIZATION:

Herbal medicine has always relied on crude extracts and decoctions based on old knowledge. But new technology is quickly bringing this field up to date. It is now possible to improve extraction, formulation, quality control, clinical evaluation, and personalized healthcare delivery. These new ideas link old ways with scientific rigor, which makes phytomedicines safer, more effective, and easier to get around the world[52]. Supercritical fluid extraction (SFE), ultrasonic-assisted extraction (UAE), microwave-assisted extraction (MAE), and pressurized liquid extraction (PLE) are all advanced extraction methods that have changed the way bioactive compounds are isolated[53].

Artificial intelligence (AI), machine learning (ML), and data analytics have a big effect on research into herbal medicine. AI-based platforms use patient genomics and metabolomics to look at huge phytochemical datasets, guess how bioactive components will interact, improve formulation designs, and help create personalized herbal therapies. Computational tools make it faster to find new drugs, which makes the process more accurate and less expensive[54].

10.FUTURE DIRECTIONS :

Herbal medicine is advancing rapidly due to scientific validation, emerging technologies, and shifts in global healthcare priorities. Future directions emphasize the integration of traditional methodologies with contemporary scientific approaches to develop safer, more effective, and individualized botanical therapies for a diverse population[55]. Digital technologies and artificial intelligence (AI) are changing every part of the research and practice of herbal medicine. AI-powered platforms can now help find new compounds, guess how plant metabolites will work together, and make herbal formulations that are specific to a person's genetics and health history[56]. High-performance liquid chromatography (HPLC), mass spectrometry, and DNA barcoding are all new ways that analytical chemistry is helping the whole industry make sure that botanicals are pure, strong, and easy to find [57].

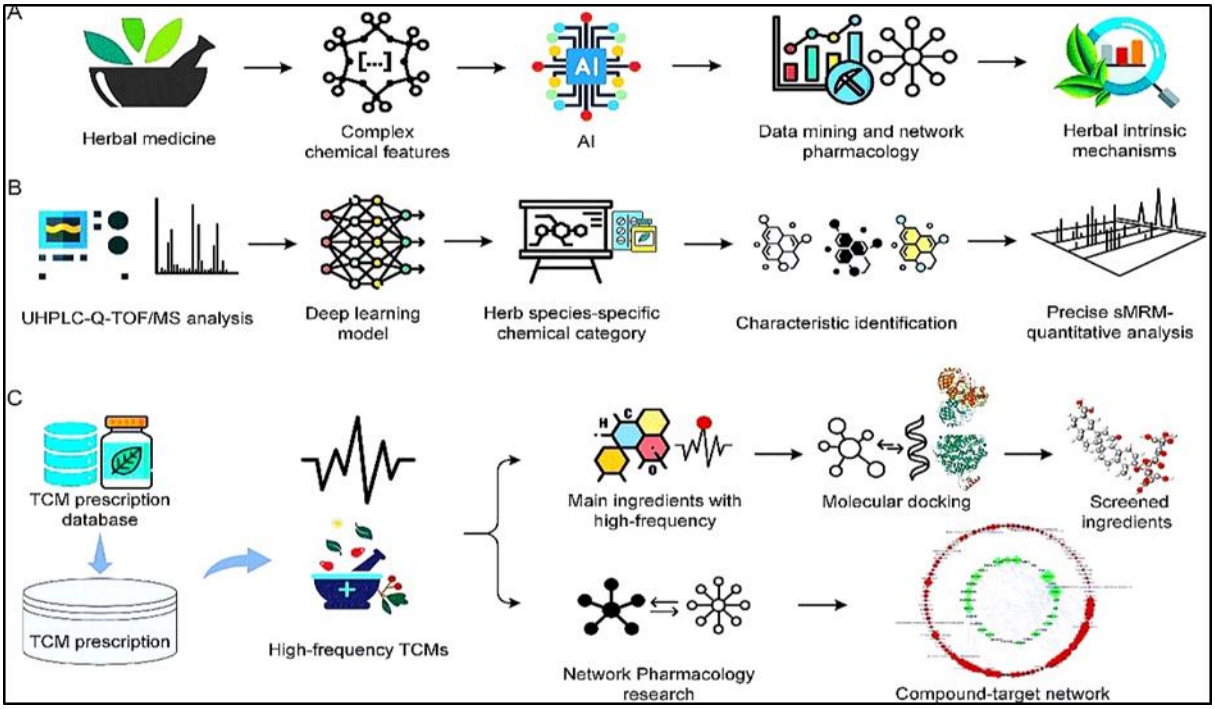

Figure 4: Future Directions In Herbal Medicine

Zhang Y, Li X, Chen H. Future directions in herbal medicine [Internet]. In: Advances in Traditional Chinese Medicine Research. Beijing: Springer Nature; 2023 [cited 2025 Oct 19].

11. CONCLUSION:

Herbal medicine is at a historic crossroads between old traditions and new technologies. Strict scientific validation is pushing the field to the front of global healthcare. Today, evidence-based medicine is looking at and using ethnobotanical knowledge from cultures like Ayurveda, Traditional Chinese Medicine, and Native American healing in new ways. This is creating new ways to treat both short-term and long-term conditions. We need advanced clinical trials and systematic reviews to be sure that something is safe, works, and helps patients. Some of the technologies that make it possible to find new bioactive compounds and standardize herbal extracts are high-throughput genomic screening, metabolomics, and advanced analytical chemistry. Pharmacogenomics, bioinformatics, and digital health technologies back the idea of personalized herbal medicine, which means changing the ingredients based on a person's health and genetics.

REFERENCES:

1. Yuan H, Ma Q, Ye L, Piao G. The Traditional Medicine and Modern Medicine from Natural Products. Molecules. 2016 Apr 29;21(5):559.
2. Xu Q, Bauer R, Hendry BM, Fan TP, Zhao Z, Duez P, *et al*. The quest for modernisation of traditional Chinese medicine. BMC Complement Altern Med. 2013 Dec;13(1):132.
3. Yagüe E, Sun H, Hu Y. East Wind, West Wind: Toward the modernization of traditional Chinese medicine. Front Neurosci. 2022 Nov 10;16:1057817.
4. Fung HN, Wong CY. Exploring the modernization process of traditional medicine: a Triple Helix perspective with insights from publication and trademark statistics. Social Science Information. 2015 Sept;54(3):327–53.
5. Mortada EM. Evidence-Based Complementary and Alternative Medicine in Current Medical Practice. Cureus. 2024 Jan 10 [cited 2025 Sept 20]; https://www.cureus.com/articles/215334-evidence-based-complementary-and-alternative-medicine-in-current-medical-practice

6. Dubale S, Usure RE, Mekasha YT, Hasen G, Hafiz F, Kebebe D, *et al.* Traditional herbal medicine legislative and regulatory framework: a cross-sectional quantitative study and archival review perspectives. Front Pharmacol. 2025 Jan 30;16:1475297.
7. Etaware P, America O, Egara O, Ekun V. Herbal Medicine: Scientific Validation and Future Prospects. IJPC. 2025 Aug 18;11(3):67–75.
8. Subbarayappa B. Siddha medicine: an overview. The Lancet. 1997 Dec;350(9094):1841–4.
9. Mahady GB. Global Harmonization of Herbal Health Claims. The Journal of Nutrition. 2001 Mar;131(3):1120S-1123S.
10. Krsnik S, Erjavec K. Factors Influencing Use of Medicinal Herbs. Journal of Patient Experience. 2024 Jan 1;11:23743735241241181.
11. Ernst E. Herbal Medicines: Balancing Benefits and Risks. In: Bock G, Goode J, editors. Novartis Foundation Symposia. 1st ed. Wiley; 2007 [cited 2025 Sept 20]. p. 154–72. https://onlinelibrary.wiley.com/doi/10.1002/9780470319444.ch11
12. L. Pastushenkov A. Phytotherapy in Total Treatment-and-Prophylactic Actions of Health Care and Training in Russia. Biomed Pharmacol J. 2017 Sept 28;10(3):1469–74.
13. Twaij BM, Hasan MdN. Bioactive Secondary Metabolites from Plant Sources: Types, Synthesis, and Their Therapeutic Uses. IJPB. 2022 Feb 21;13(1):4–14.
14. Petrovska B. Historical review of medicinal plants′ usage. Phcog Rev. 2012;6(11):1.
15. Khan H. Medicinal Plants in Light of History: Recognized Therapeutic Modality. J Evid Based Complementary Altern Med. 2014 July;19(3):216–9.
16. Jamshidi-Kia F, Lorigooini Z, Amini-Khoei H. Medicinal plants: Past history and future perspective. J Herbmed Pharmacol. 2018 Jan 1;7(1):1–7.
17. Fitzgerald M, Heinrich M, Booker A. Medicinal Plant Analysis: A Historical and Regional Discussion of Emergent Complex Techniques. Front Pharmacol. 2020 Jan 9;10:1480.
18. Dal Cero M, Saller R, Leonti M, Weckerle CS. Trends of Medicinal Plant Use over the Last 2000 Years in Central Europe. Plants. 2022 Dec 27;12(1):135.
19. Jaiswal YS, Williams LL. A glimpse of Ayurveda – The forgotten history and principles of Indian traditional medicine. Journal of Traditional and Complementary Medicine. 2017 Jan;7(1):50–3.
20. Balkrishna A, Sharma N, Srivastava D, Kukreti A, Srivastava S, Arya V. Exploring the Safety, Efficacy, and Bioactivity of Herbal Medicines: Bridging Traditional Wisdom and Modern Science in Healthcare. Future Integr Med. 2024 Mar 25;3(1):35–49.
21. Potenza MA, Montagnani M, Santacroce L, Charitos IA, Bottalico L. Ancient herbal therapy: A brief history of Panax ginseng. Journal of Ginseng Research. 2023 May;47(3):359–65.
22. Posadzki P, Ernst E, Terry R, Lee MS. Is yoga effective for pain? A systematic review of randomized clinical trials. Complementary Therapies in Medicine. 2011 Oct;19(5):281–7.
23. Hoyez AC. The ‘world of yoga’: The production and reproduction of therapeutic landscapes. Social Science & Medicine. 2007 July;65(1):112–24.
24. Balkrishna A, Sharma N, Srivastava D, Kukreti A, Srivastava S, Arya V. Exploring the Safety, Efficacy, and Bioactivity of Herbal Medicines: Bridging Traditional Wisdom and Modern Science in Healthcare. Future Integr Med. 2024 Mar 25;3(1):35–49.
25. Silveira D, Boylan F. Medicinal Plants: Advances in Phytochemistry and Ethnobotany. Plants. 2023 Apr 17;12(8):1682.
26. Akhtar S, Bachheti RK, Bachheti A, Naithani S, Bisht B, Vashishth DS, *et al*. Review of Traditional and Phytochemical Compounds in Herbs, Shrubs, Climbers, and Trees from Jammu and Kashmir Union Territory of Indian Subcontinent Used in Management of Respiratory Disorders. Natural Product Communications. 2025 Apr;20(4):1934578X251338522.
27. Vendrapati RR, Suresh S, Bhat S, Bindu KH, Mahadevaswamy SR, Latheef SSA, *et al*. A Comprehensive Review of Selected Traditional Medicinal Plants: Status, Phytochemistry, Medicinal Properties, Cultivation, and Demand. Pharmacogn Rev. 2024 Aug 15;18(35):24–46.
28. Dubale S, Kebebe D, Zeynudin A, Abdissa N, Suleman S. Phytochemical Screening and Antimicrobial Activity Evaluation of Selected Medicinal Plants in Ethiopia. JEP. 2023 Feb;Volume 15:51–62.
29. Kumar A, P N, Kumar M, Jose A, Tomer V, Oz E, *et al.* Major Phytochemicals: Recent Advances in Health Benefits and Extraction Method. Molecules. 2023 Jan 16;28(2):887.
30. Goldman P. Herbal Medicines Today and the Roots of Modern Pharmacology. Ann Intern Med. 2001 Oct 16;135(8_Part_1):594–600.
31. Thamizhoviya G. Global Integration of Traditional and Modern Medicine: Policy Developments, Regulatory Frameworks, and Clinical Integration Model. Future Integr Med. 2025 Sept 4;000(000):000–000.

32. Ghazi-Moghadam K, Inançlı HM, Bazazy N, Plinkert PK, Efferth T, Sertel S. Phytomedicine in Otorhinolaryngology and Pulmonology: Clinical Trials with Herbal Remedies. Pharmaceuticals. 2012 Aug 20;5(8):853–74.

33. Kadiri SK, Tiwari P. Integrating traditional medicine with network pharmacology for Alzheimer's treatment. Health Sciences Review. 2025 June;15:100223.

34. Zimmermann-Klemd AM, Reinhardt JK, Winker M, Gründemann C. Phytotherapy in Integrative Oncology—An Update of Promising Treatment Options. Molecules. 2022 May 17;27(10):3209.

35. Berman BM, Lao L, Langenberg P, Lee WL, Gilpin AMK, Hochberg MC. Effectiveness of Acupuncture as Adjunctive Therapy in Osteoarthritis of the Knee: A Randomized, Controlled Trial. Ann Intern Med. 2004 Dec 21;141(12):901–10.

36. Block KI, Gyllenhaal C, Mead MN. Safety and Efficacy of Herbal Sedatives in Cancer Care. Integr Cancer Ther. 2004 June;3(2):128–48.

37. Zhang J, Onakpoya IJ, Posadzki P, Eddouks M. The Safety of Herbal Medicine: From Prejudice to Evidence. Evidence-Based Complementary and Alternative Medicine. 2015;2015:1–3.

38. Woo CSJ, Lau JSH, El-Nezami H. Herbal Medicine. In: Advances in Botanical Research. Elsevier; 2012 [cited 2025 Sept 20]. p. 365–84. Available from: https://linkinghub.elsevier.com/retrieve/pii/B978012394591400009X

39. Mugale MN, Dev K, More BS, Mishra VS, Washimkar KR, Singh K, *et al*. A Comprehensive Review on Preclinical Safety and Toxicity of Medicinal Plants. Clinical Complementary Medicine and Pharmacology. 2024 Mar;4(1):100129.

40. Posadzki P, Watson LK, Ernst E. Adverse effects of herbal medicines: an overview of systematic reviews. Clinical Medicine. 2013 Feb;13(1):7–12.

41. Cho E, Kim S, Son MJ. Common adverse events of herbal formulas for developing reporting forms for clinical practice and research: An overview of systematic reviews. Integrative Medicine Research. 2025 Mar;14(1):101118.

42. Zhang P, Ye Y, Yang X, Jiao Y. Systematic Review on Chinese Herbal Medicine Induced Liver Injury. Kuete V, editor. Evidence-Based Complementary and Alternative Medicine. 2016 Jan;2016(1):3560812.

43. Wang H, Chen Y, Wang L, Liu Q, Yang S, Wang C. Advancing herbal medicine: enhancing product quality and safety through robust quality control practices. Front Pharmacol. 2023 Sept 25;14:1265178.

44. Fu PP. Quality assurance and safety of herbal dietary supplements. Journal of Food and Drug Analysis. 2020 July 14 [cited 2025 Sept 20];15(4): https://www.jfda-online.com/journal/vol15/iss4/18

45. Paul T, Kumar KJ. Standardization of Herbal Medicines for Lifestyle Diseases. In: Dhara AK, Mandal SC, editors. Role of Herbal Medicines. Singapore: Springer Nature Singapore; 2023 [cited 2025 Sept 21]. p. 545–57. https://link.springer.com/10.1007/978-981-99-7703-1_27

46. R Warhade V, Dighe A. A Review on Quality control and Standardization of herbals. RJST. 2022 Nov 14;247–52.

47. Zuberi SA, Tasleem F, Malik N, Jaffar F, Aamir N. Drug Standardization And Its Applications To Herbal/Skin Care Formulations: A Review. JPTCP. 2024 Aug 30 [cited 2025 Sept 20]: https://www.jptcp.com/index.php/jptcp/article/view/9701

48. Govindaraghavan S. Quality Assurance of Herbal Raw Materials in Supply Chain: Challenges and Opportunities. Journal of Dietary Supplements. 2008 Jan;5(2):176–212.

49. Gatt AR, Vella Bonanno P, Zammit R. Ethical considerations in the regulation and use of herbal medicines in the European Union. Front Med Technol. 2024 June 14;6:1358956.

50. Parvin S, Reza A, Das S, Miah MdMU, Karim S. Potential Role and International Trade of Medicinal and Aromatic Plants in the World. EJFOOD. 2023 Oct 20;5(5):89–99.

51. Alostad AH, Steinke DT, Schafheutle EI. International Comparison of Five Herbal Medicine Registration Systems to Inform Regulation Development: United Kingdom, Germany, United States of America, United Arab Emirates and Kingdom of Bahrain. Pharm Med. 2018 Feb;32(1):39–49.

52. Bareetseng S. The Worldwide Herbal Market: Trends and Opportunities. J Biomed Res Environ Sci. 2022 May;3(5):575–84.

53. Kurnaz ML, Aksan Kurnaz I. Commercialization of medicinal bioeconomy resources and sustainability. Sustainable Chemistry and Pharmacy. 2021 Sept;22:100484.

54. Technological Advancements in Herbal Medicine: Enhancing Efficacy, Safety, and Accessibility. Au Herb Insight. 2019 Mar 1;1(1):1–9.

55. Poudeyal MR, Meilby H, Hart R, Ghimire SK. Sustainable harvest of a threatened medicinal herb: Empirical evidence for spatially and temporally specific management of Neopicrorhiza scrophulariiflora. Perspectives in Plant Ecology, Evolution and Systematics. 2024 Sept;64:125799.

56. Abbass K, Qasim MZ, Song H, Murshed M, Mahmood H, Younis I. A review of the global climate change impacts, adaptation, and sustainable mitigation measures. Environ Sci Pollut Res. 2022 June;29(28):42539–59.

57. Abdian S, Fakhri S, Moradi SZ, Khirehgesh MR, Echeverría J. Saffron and its major constituents against neurodegenerative diseases: A mechanistic review. Phytomedicine. 2024 Dec;135:156097.