



Herbal Medicine in Contemporary Healthcare: Challenges and Opportunities in Evidence-Based Integration

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SUMMARY

The people's enhanced curiosity regarding choices related to complementary and alternative medicine has contributed to the enhanced use of herbal medicine in updated healthcare. However, there are pros and cons of merging evidence-based herbal therapies into occidental healthcare. The chapter covers the advanced applications of some plants likewise Ginseng, Chamomile, and Withania coagulans. The herbs can ameliorate several health conditions because of their anxiolytic, adaptogenic, and anti-inflammatory qualities. The common people prefer herbal remedies over Western medications because of their low adverse effects and several other reasons which are discussed in detail. The integration of herbal medicines into standard treatment reflects noteworthy hindrances despite their immense usage such as ambiguous safety profile, unclear nutritional content quantity, and inconsistent dosage. Moreover, the chapter also covers the necessities and challenges regarding regulatory frameworks, pharmacovigilance, and safety monitoring systems. The chapter emphasizes underscoring the critical need and importance of conducting in-depth clinical and research trials to narrow the informational differences between herbal remedies and conventional medicine. This will contribute to the increased legitimacy and acceptability of herbal medicine within the framework of evidence-based healthcare.

INTRODUCTION

Herbal medicines are a method of treatment and prevention of a wide variety of diseases by using plant or plant products. In herbal medicines, plants may be used as a whole their extraction, or any part of the plant that has therapeutic properties (Stéphane et al., 2021). "Simply we can define it plant dependent resolution of health and wellness" Herbal drugs are generally used worldwide (Abdallah et al., 2023). People belonging to any gender believe upon herbal remedies equally, moreover, people having any type of socioeconomic background whether they belong to rich or poor communities still practice herbal drugs in their lives for treatment of so many health-related issues. Industrialized as well as developing nations used herbal drugs commonly. A common use of herbal products is because it shows community-based and standard bequest, addresses lavish necessities and well-being aims, and offers accessible and sensible clinical benefits conclusion. According to the World Health Organization (WHO), people use herbal prescriptions 2-3 times more than conventional remedies. 70-80% of the public in underdeveloped countries depend upon herbal dugs. Normal drugs are grooved on considering the way that they are

considered to be safer, unobtrusive, and approachable. For example: digoxin (from foxglove), quinine (from cinchona bark), and morphine (from the opium poppy) (Vickers & Zollman, 1999). Different people use local prescriptions close by endorsed treatment and don't pay all due respects to their practitioners (Graham et al., 2021).

There are various clarifications due to which patients turn to herbal medicines. People of different countries acknowledge that where a disease presumes its treatment is moreover there in plants. Also, destructive events happen abundantly with standard drugs that are very difficult to manage, yet the local solution is significantly safer, and its toxicity is easily manageable (Leichtweis et al., 2022). In Pakistan, people use Unani medications, and there are different approaches to including plants for a home fix. People are similarly fascinated by homeopathic solutions in northern areas. in addition, Sanyasis is practicing normal drugs as an Ayurvedic technique for treatment. The prevalent ordinary plan of medicine in Pakistan is the Unani system. In tribal areas, as there is no game plan for medication people know about neighborhood plants for fundamental prosperity issues (Jacob et al., 2024).

HISTORICAL BACKGROUND

Several evidences point to medicinal plants as the source of the first and most widely used form of medicine. The majority of medicines were derived directly from the place of origin of plants or animals until the 20th century. Here is a more concise and exact explanation of the history of natural medication. Earliest Period (3000 before the Common Era); Early people found curative properties of plants into and out of perception, trial, and error, and experimentation Antiquated Civilizations (3000 before common Era- 500 common Era), Egyptian Medicine (1550 before common Era): Used herbs like garlic, onion, and opium for restorative purposes. Galen generated a system of herbal medicine, using plants like *ginger* and *Chamomile*. Ayurvedic Medicine (500 before the Common Era); Originates in ancient India, using herbs like turmeric and neem. Alchemist Era (500 - 1500 common Era); People save the previous knowledge through which new remedies comes into begin. Renaissance (1500 - 1700 common Era); Establishment of botanical garden down in this era Eighteenth and nineteenth Hundreds of years; Endorsement of homegrown medication and foundation of pharmacopeias, similar to the "London Pharmacopeia" Twentieth 100 years; Herbal medicine bear competition from not of natural origin pharmaceuticals. In this Era; Increased knowledge of natural medicine's advantageous effects. This extended history features the rich and different development of homegrown medication across societies (Yadav et al., 2024).

CURRENT TRENDS IN HERBAL MEDICINE USAGE

Several illnesses can be effectively and safely treated with the proper application of herbal remedies. The patient is the primary judge of the herbal medications' efficacy. Herbal medications exhibit varying degrees of potency, which can be attributed to factors such as genetic variation, cultivation circumstances, harvesting timing, and technique, exposure to light, air, and moisture, and preservation methods. There are currently claims being made that herbal medicines can treat more serious disorders for which there is no conventional knowledge. Consequently, to guarantee the safety, effectiveness, and quality of herbal medicines as well as to support certain purposes, scientific and clinical data must be gathered, and regulatory requirements for these products are required (Atmakuri & Dathi, 2010). Tisanes, another name for herbal teas, are drinks prepared by infusing or decocting herbs, spices, or other plant material. They are often drunk for their restorative and stimulating qualities. Nowadays, a large range of botanical food supplements and products derived from plants, algae, fungi, or lichens are available on the EU market. These items usually bear the word "natural" and make several claims about potential health advantages. They are available for purchase online, in farmers markets, pharmacies, supermarkets, and specialty stores (Alexieva, et al., 2020).

Thirteen medications made from natural ingredients received approval in the US between 2005 and 2007. Of the 252 medications on the World Health Organization's (WHO) list of essential medicines, over 100 are based on natural products and 11% are solely derived from plants (Enioutina et al., 2017). The use of herbal remedies as dietary supplements

to prevent disease or as complementary and alternative medicine (CAM) to treat illness has grown in popularity in recent years. There is a large range of herbal medicines and goods on the market anywhere in the world. According to estimates, a sizeable portion of the populace in developed nations including the USA (42%) Canada (70%), France (49%), Australia (48%), and Belgium (31%) have utilized complementary and alternative medicine (CAM) at least once for medical care. In wealthy nations, the growing trend of using herbal therapy is an indirect sign of discontent with traditional treatment (Wang et al., 2021). Many of the medications used in traditional medicine today come from natural plants. For example, *Galega officinalis* is the source of metformin, a medication used frequently to treat type 2 diabetes with hypoglycemic action. The most popular "herbal dietary supplement" in the United States is *Marrubium vulgare*, followed by *echinacea* (different species), ivy leaf (*Hedera helix*), black cohosh (*Actaea racemosa*), yohimbe (*Pausinystalia johimbe*), and saw palmetto (*Serenoa repens*). They are the top-selling herbal supplements and add to the market earnings of U.S. market sales mainstream (Williamson, et al., 2020).

PUBLIC PERCEPTION AND DEMAND

The results indicate that recommendations and personal networks (63.2%) are the most successful means of disseminating information about herbal medicine, with public marketing having a less significant impact. Because of their perceived safety and efficacy, a higher percentage of people (74.8%) still use and accept herbal medicine products (HMPs). Specifically, 45.1% of respondents said that compared to conventional medication, herbal medicines work "a bit better" (Obahiagbon & Ogwu, 2024). The use of herbal remedies is on the rise in the United States. Commercially prepared herbal products are beginning to establish a foothold in community pharmacies across the nation, indicating that the market is continuing to expand. 73% of pharmacists who responded said that their store carried herbal products that had been prepared commercially. Because pharmacists' perceptions of these products have the potential to influence attitudes and behavior, attitudinal items were included in the study (Nichols, et al., 2021). Global use of herbal medicine and supplements has increased terrifically in the last three decades. The majority of respondents to the survey conducted in India give herbal medicine a 6-10 rating, and consumers prefer Ayurveda over all other treatment methods because there are no scientifically supported benefits. Purchasers don't give inclination to the natural drugs in significant illnesses. 69% of respondents to the survey believe that Ayurvedic medicine will replace allopathic medicine shortly (Sharma, 2021).

Growing interest has been seen in natural products, particularly those made from plants, and alternative medicines in recent years. Several factors contribute to the interest in drugs derived from plants. These include the fact that conventional medicine can be ineffective (e.g., have side effects and ineffective therapy), that improper or abusive use of synthetic drugs can result in side effects and other issues, that a significant portion of the world's population lacks access to conventional pharmaceutical treatment, and that folk medicine and ecological awareness suggest "natural products

are harmless (Kumar, 2009). Examining global markets offers substantial growth potential, particularly in underdeveloped nations where herbal medicine is deeply ingrained in the culture. The market for herbal medicines has enormous growth potential despite obstacles and regulations because of the growing desire for natural health solutions worldwide, the incidence of lifestyle disorders, rising awareness, the validation of research, and the market's integration with traditional healthcare (Bhattacharjee et al., 2024).

COMMONLY USED HERBAL REMEDIES

GINSENG

Ginseing is a well-known herb with a range of health benefits. It is often referred to as "man-root" due to its root's human-like shape. The plant comes in several varieties, each offering its own unique set of benefits. *Panax (P.)* Ginseing often referred to as (Asian Ginseing) and *Panax quinquefolius*, commonly known as (American Ginseing), is an herbaceous perennial native to the deciduous woodlands of North America. The Greeks used the term "panacea" leading to the current word "*Panax*" referring to Asian Ginseing (*P. Ginseing*) that is native to Korea, China, and Eastern Siberia and a key constituent of several popular herbal remedies for more than 2000 years (Panossian et al., 2021). A popular traditional Chinese medicine referred to as "Shen-Nong-Ben-Cao-Jing," also contained Ginseing and was used as a potent medicine for centuries. Moreover, medicinal literature also suggests the extensive use of Ginseing for promoting lung and spleen health and boosts the life force (Liu et al., 2020).

Active Compound

Contempo investigations and modern studies have unveiled the phytochemical composition and pharmacological characteristics of Ginseing. As for the phytochemicals, more than 200 bioactive compounds have been found such as amino acids, volatile oils, flavonoids, and saponins. Among them, triterpene saponins also known as ginsenosides have been analyzed for their conceivable ameliorative and restorative potential (Karmazyn & Gan, 2021). On the other hand, pharmacological investigations reveal the substantial benefits of Ginseing in cardiovascular and cerebrovascular disorders (CCVDs) in clinical trials. TMC reports that most potent herb to promote vital energy is Ginseing (Liu et al., 2020).

Chemical Constituent

Ginsenosides, polysaccharides (GPS), polyacetylenes, sterols, unstable oils, proteins, polypeptides, amino acids, nutrients, natural acids, and minor components are a couple of the numerous bioactive substances related to Ginseing (Table 1). Of them, ginsenosides stand out enough to be noticed because of their critical likely in the field of anticancer exploration. Even though Ginseing contains extra substances like sterols, volatile oils, polysaccharides, and polyacetylenes that additionally add to its anticancer properties, ginsenosides are especially huge on account of their notable anticancer characteristics (Ni et al., 2022).

Table 1: Active compounds present in *Ginseng* and their percentage

Active component	Percentage
Saponins	4 - 15%
Polysaccharides	28.5%
Volatile Oil	0.081 - 0.223%
Polyacetylenes	0.04%

Pharmacological Properties

The adaptogenic characteristics of *P. Ginseing* are notable for assisting the body with remaining offset and adapting to pressure. As an adaptogen, Ginseing upgrades energy and actual execution while lessening the adverse consequences of being old enough and stressed (Irfan et al., 2020). Ginsenosides which is the active compound of *P. Ginseing* prevents the growth and spread of several malignancies by changing several signaling pathways and gene expression. While few clinical trials have been conducted, the majority of current ginsenoside anticancer research was conducted using mice xenograft models and cancer cell lines. Many investigations focused on the ginsenosides Rg3 and Rh2, which have been demonstrated to have potent anticancer effects. Ginsenosides inhibit cancer cell growth, viability, invasion, and migration in addition to stimulating autophagy, cell cycle arrest, and death. It has also been established that ginsenosides work in concert with current cancer treatments. (Hong et al., 2021).

Pharmacokinetics of Ginseng

The Ginseng effect can differ depending on whether a single ginsenoside or a Ginseing extract is administered, due to variations in absorption and metabolism. Additionally, the metabolic profile of a ginsenoside can change based on the method of administration. For example, when Rd is administered intravenously, Rb1 becomes the predominant metabolite. In contrast, when Rd is taken orally, Rg3 is the main metabolite. Despite this, the diverse and complex chemical structures of distinct ginsenosides mean that the pharmacokinetic profile of Ginseing is still not fully elucidated (Kim et al., 2022).

Therapeutic Effects

Ginseing exhibits notable antioxidant and anti-inflammatory properties that contribute to health benefits. Ginseing can improve memory and reduce stress. Preliminary evidence suggests it may also help prevent anxiety, depression, Alzheimer's disease, and cognitive decline. Ginsenosides in Ginseing seem to combat free radicals, regulate inflammation, and maintain cell health. These actions may contribute to a reduced risk of developing certain types of cancer. Ginseing has potential benefits for reducing oxidative damage and enhancing cellular energy production suggesting that it may play a role in mitigating fatigue and improving physical performance (Flagg, 2021.)

CHAMOMILE

Chamomile, a long-utilized medicinal herb, includes Roman *Chamomile* (*Chamaemelum nobile*) and German

Chamomile (*Chamomilla recutita*), both from the Asteraceae family. Dried *Chamomile* flowers are rich in terpenoids and flavonoids, enhancing their therapeutic properties. *Chamomile* is used to address various conditions, including hemorrhoids, gastrointestinal issues, rheumatic pain, ulcers, wounds, menstrual disorders, inflammation, hay fever, and muscular spasms. It is also popular in aromatherapy and cosmetics. Herbal tea is the most common *Chamomile* preparation, with other forms also available (Dai et al., 2022).

Bioactive Compound

It contains diverse bioactive components used in cosmetic and medical formulations. Its volatile oil, comprising 0.24% to 1.9% of the plant, transitions from vivid blue to deep green upon steam distillation, eventually darkening to yellow with storage, though it remains potent. *Chamomile* includes over 120 secondary metabolites, with 36 flavonoids and 28 terpenoids identified. The essential oil from German *Chamomile* predominantly contains α -bisabolol and azulenes, including acetylene derivatives and chamazulene. Key phenolic compounds in the flowers are the flavonoids apigenin, quercetin, and patuletin as glucoside and various acetylated derivatives (Dai et al., 2022).

Traditional uses

It is widely used in Traditional Chinese Medicine (TCM) for gastrointestinal issues, cramping, rashes, and mild infections. It supports the stomach and nerves and is used for persistent headaches, constipation, inadequate sweating, joint swelling, and urinary system abnormalities (Fig. 1). The herb enhances appetite and reduces swelling and sweating. In "Chinese Herbs. Uyghur Medicine Volume," *Chamomile* is noted as an appetizer, diuretic, brain and muscle strengthener, stomach nourisher, and menstruation flow enhancer. It addresses amenorrhea, joint discomfort and swelling, stomach deficiency, anorexia, muscular relaxation, and urine retention (Dai et al., 2022).

Mechanism of action in CNS-related disorder

Chamomile tea, used for relaxation and sleep disorders, contains the flavonoid apigenin, which may have sedative

effects by binding to benzodiazepine receptors in the brain. Studies show that a *Chamomile* crude fraction (30 mg/kg) reduces locomotor activity in mice, with effects comparable to diazepam. Recent research also demonstrates that *Chamomile* significantly reduces anxiety in zebrafish larvae. Depression in humans is thought to be linked to neuropeptide substance P, which triggers depression through its receptor, neurokinin-1. *Chamomile* extracts have shown neurokinin-1 receptor antagonist activity. Additionally, *Chamomile* oil vapor inhalation reduces stress-induced Adrenocorticotrophic hormone (ACTH) levels in ovariectomized rats. Flavonoid components in *Chamomile* also appear to affect central neurotransmitter activities, decreasing serotonin, dopamine, and monoamine oxidase activity while increasing catecholamine synthesis and noradrenaline activity (Sah et al., 2022).

Pharmacological Properties

Anti-inflammatory and Anti-thrombotic Activity: *Chamomile*'s anti-inflammatory effects are largely attributed to its flavonoids, which inhibit the transcription factor nuclear factor kappa B (NF- κ B). Research indicates that *Chamomile* volatile oil demonstrates significant anti-inflammatory properties in animal models by reducing inflammatory mediators such as TNF- α and IL-1 β . Consequently, *Chamomile* is commonly used to treat various inflammatory conditions, including conjunctivitis, mastitis, dermatitis, cystitis, and colitis. Cardiovascular diseases (CVD) are a leading cause of death worldwide. *Chamomile* extract exhibits antithrombotic properties by extending hemostasis and coagulation. Luteolin, a compound in *Chamomile*, reduces oxidative stress associated with ADP-induced carotid artery thrombosis in rats. Research shows that a polyphenol-polysaccharide conjugate from *Chamomile* decreases platelet aggregation. These findings support *Chamomile*'s potential in mitigating thrombotic conditions.

Hypoglycemic effect: *Chamomile* extract reduces fasting blood glucose levels and improves glucose tolerance in both normal and diabetic mice. It also mitigates the effects of external glucose. It also found that *Chamomile*'s total flavonoids lower blood glucose levels in diabetic mice by enhancing insulin secretion and glucose tolerance while reducing fibrinogen, glycated hemoglobin, and glycated serum protein levels. It also observed that *Chamomile* extract alleviates oxidative stress and protects islet cells in diabetic rats treated with streptozotocin (Dai et al., 2022).

WITHANIA COAGULANS

Since ancient times, plants have been used for their medicinal properties, with many offerings' therapeutic benefits due to their bioactive components. Among these, *Withania* (*W.*) *coagulans* stand out for their potent pharmacological and nutraceutical qualities, particularly in Ayurvedic medicine. This plant, which is native to South Asia, North Africa, and the Mediterranean, is well-known for its coagulating ingredients, which have made it useful for coagulating milk. Among 23 species found in *Withania* genus, the two most important species are *W. somnifera* and *W. coagulans*. The ability of *W.coagulans* to coagulate milk is



Fig 1. Therapeutic Uses of *Chamomile* (El Mihyaoui et al., 2023)

accredited to specific enzymes found in its berries. Almost all parts of plants (leaves, roots, fruits, etc.) have been analyzed separately and in combination to explore their medicinal uses. Ripe fruit can be utilized for numerous health issues such as asthma, dyspepsia, sedation, depression, and wound healing. Botanical images and global research also exhibit the extensive applications of plant leaves and stems in traditional remedies (Khan et al., 2021). The evergreen herb *W. coagulans* is usually 25 to 36 inches high, possessing firm grey stems and ellipsoidal leaves. The plant produces bunches of dioeciously yellowish flora in its axillary cavity. The fruit is a red globose berry having a radius of 3 to 4 millimeters alongside a leathery calyx. The seeds possess a strong fruity odor, dark brown color, translucent appearance, and ear-like shape (Gupta et al., 2022).

Traditional Uses

The plant *W. coagulans* is used not only alone but also in combination with other herbal species in various traditional herbal practices for health management (Fig. 2). For instance, in the Indian and Pakistani regions, the stems and branches of *W. coagulans* have been popular for improving and maintaining dental hygiene purposes. Moreover, the smoke produced by the combustion of plants is utilized for relieving toothaches and cleaning the oral cavity. Furthermore, in traditional medicinal systems, it is usually prescribed for the therapeutic management of smallpox. The fruit is used mostly for treating common respiratory ailments such as asthma. The plant's seeds are utilized for their anti-inflammatory and antioxidant effect against piles, renal disorders, and other related ailments. Additionally, its blood-purifying characteristics have also been reported. Traditional practitioners have also reported its use in treating diabetic symptoms due to its anti-hyperglycemic and anti-hyperlipidemic effects (Gupta et al., 2022).

Active Compounds

It possesses major chemical constituents referred to as withanolides, which are described as polyhydroxy steroidal lactones particularly found in the roots and leaves of plants. The ergostane framework comes up with the foundation for the C-28 steroidal lactone structure that characterizes these phytochemicals. The dry plant mass contains withanolide content in 0.001% to 0.5% proportion. The classification has two basic types based on structure: those containing varied carbocyclic frameworks and those with unimpaird skeletons, circumscribing both distinct α -oriented side chains and classical β -oriented side chains (Khan et al., 2021). Among the polysaccharide content present in plant seeds, approximately 18% of carbohydrates are deficient of β -glycosidic connections and contain a steady D-glucose to D-arabinose ratio. Additionally, the 12–14% of oil present in seeds is a rich reservoir of the two major compounds (β -sitosterol and linoleic acid) critical for controlling hypercholesterolemia. However, it contains many other active phytochemicals which were characterized through its lab analysis by using Fourier Transform Infrared (FTIR) spectroscopy and Gas Chromatography-Mass Spectrometry (GC-MS) (Tahir et al., 2024).

Mechanism of Action

The key chemical constituents such as glycowithanolides and withanolides found in *W. coagulans* have been responsible for its potent ameliorative action against the central nervous system (CNS) associated disorders for instance, manic and depressive disorders, epilepsy and catalepsy, and disturbances in sleep patterns such as insomnia, sleep paralysis. Various Clinical studies also reveal the promising action of *W. coagulans* fruit extract against CNS depression when tested in rabbits, canines, and mice. It also showed the neurotransmitter-modifying capability of extracts of other plant parts. Particularly, in albino rats, the reduced exploratory action, sedation, and hypothermia have been associated with CNS depression induced by total alkaloids, and alcoholic and aqueous fruit extracts (Fig. 3). Additionally, 3 β -hydroxy-2,3-dihydrowithanolide F has been identified as a compound with CNS depressant activity (Gupta et al., 2022).

Pharmacological properties

Cardiovascular and Antioxidative Effect: The fruits of *W. coagulans* contain withanolides, structurally similar to aglycones, characterized by a 6-membered unsaturated lactone ring attached to the steroidal ring at C20. These compounds are linked to cardiovascular effects. Notably, 3 β -hydroxy-2,3-dihydrowithanolide F has been reported to mildly lower blood pressure and aid in cardiac arrest in dogs. Withaferin A,



Fig 2. Different parts of *W. coagulans* and their health benefits

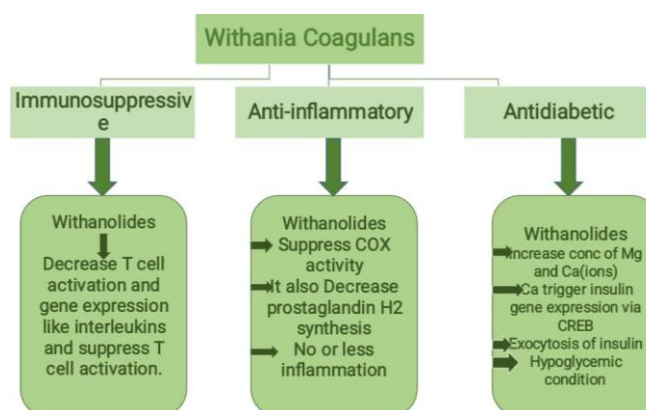


Fig 3. Mode of action of *W. coagulans* in various health

another withanolide, is crucial in managing inflammation associated with cardiovascular diseases. The term "antioxidative potential" means it can inhibit free radicals, thereby affecting physiological chemical reactions. Many withanolides found in *W. coagulans* are noted for their significant antioxidative properties.

Anti-arthritic activity: Rheumatoid arthritis is an autoimmune disorder characterized by chronic inflammation. The primary chemical constituents of *W. coagulans* fruits, including alkaloids and withanolides, play a role in managing this condition. Both methanolic and hydroalcoholic extracts of *W. coagulans* demonstrate anti-arthritic properties, with the hydroalcoholic extract potentially exhibiting greater efficacy compared to the methanolic extract. (Gupta et al., 2022).

CHALLENGES IN INTEGRATING HERBAL MEDICINE

Since immemorial times, the medicinal branch of science has attained worldwide advancements. With the usual reduction in the death rate, the average life span and living quality improves subsequently (Jansen et al., 2021). This can be accredited to the discovery of new drugs, improved modifications in the existing formulations, development of novel therapies and drug-delivery systems, and betterment of the already-approved therapeutic strategies (Mao et al., 2022). But certainly, when it comes to the utmost perfection in securing public health, it's a non-negotiable fact that there are many setbacks in the current treatments, and many cures or vaccines are yet to be discovered or invented for various diseases such as AIDS (Briggs et al., 2020). Therapeutic drugs for many pandemics such as COVID-19 and newly discovered infections are yet to be found and still disease management is done merely by symptomatic treatment (Mirzaeian et al., 2019). Another perspective is the costly treatment for the medicines which makes it almost impossible for the current Healthcare systems to secure public health in impoverished regions and underprivileged communities (Saggar et al., 2022).

Despite long-standing hard work by healthcare organizations and medical scientists and clinical researchers, the fields of medical and clinical sciences have a lot of work to do not only in attaining health equity, developing cost-effective treatment strategies but also in facing the constantly evolving viruses and prevailing disorders (Zhou et al., 2019). For instance, in the case of underdeveloped countries, common folks don't have access to the advanced healthcare system and modern therapeutic drugs, thus they depend on local or traditional complementary healthcare medicines. Therefore, the answers to certain questions such as whether the goals set for the health problems are achieved. And of course, the answer to such a question is that all efforts are in progress but we are not even near to the end yet (Parveen et al., 2020). Even in the 21st century, the unsanitary environment and substandard living style increase the disease incidence (Barkat et al., 2021). Also, even the drugs approved by the FDA have many side and adverse effects for which there is a necessity to find herbal replacement with cheaper cost and lesser side effects (Shiffman, 2017). However, whenever the topic of

integrating herbal medicine is addressed, many challenges and limitations are faced by the researchers.

The Need for Rigorous Clinical Trials

For the effective integration of plant medicine into advanced medicinal practices, extensive trials are required for them in both pre-clinical and clinical setups (Chan, 2016). The trials are crucial for the appropriate implication of not only Good Manufacturing Practices (GMP) but also Good Agricultural and Collection Practices (GACP) and for the approval of herbal medicine by the FDA. Major research can be conducted to analyze and improve the QA and QC standards of herbal medicine by following the Good Agricultural and Collection Practices (GACP) and well as the guidelines prescribed by the WHO. It includes not only the characterization of the right herbal species but also its later testing for the preparation of products on proper hygiene and decontaminated environment for the qualitative and quantitative analysis such as carrying procedures like HPLC-UV, etc. (Barkat et al., 2021). Additionally, the pharmacovigilance and pharmacokinetics of the product are found by carrying out the pharmacological analysis (Balekundri & Mannur, 2020). Pre-clinical and Clinical studies are also critical and must be according to the CONSORT guidelines to deal with the complications of the traditional herbal medicines, certifying the documents to mitigate prejudice, whereas the systemic reviews are done to find out the factors affecting the efficacy and explore the diversity of active phytochemicals.

Challenges

Though, herbal products are usually launched in the market without carrying out any vital safety, efficacy, and toxicity profiles of the drugs (Xiong et al., 2022). Various countries are deprived of the appropriate machinery and the manufacturing setup required for effective synthesis, quality control, and quality assurance tests of herbal products (Knoess & Wiesner, 2019). The healthcare staff, industrialists, researchers, and pharmacists have to face various challenges regarding legal and regulatory framework, safety and efficacy assessment, quality control, quality assurance, inadequate data for toxicity profiles, and insufficient knowledge and lack of public awareness regarding herbal medicines or products (Djaoudene et al., 2023). The major challenges faced regarding herbal products manufacturing are:

Regulatory Framework

As referred in the definition, a dietary product is a supplement that is administered and is intended to add to the diet and consists of a dietary ingredient. The dietary materials in these herbal products also consist of various minerals, vitamins, essential metabolites, and other minerals as per the requirements of the person (Knoess & Wiesner, 2019). Though according to the DSHEA (Dietary Supplement Health and Education Act) of 1994, further toxicity analysis is not required for those herbs or herbal products that are successfully marketed before 1994. Another major challenge in many countries is the regulatory and legal differences that vary from country to country. Lack of communication and information

sharing related to pharmacovigilance studies of recent herbal drugs is also another major challenge (Briggs et al., 2020). The regulatory difference creates a problem for instance, certain products are placed under the medicinal category in one region while under the dietary supplement category in another category. For instance, Vitamin E is classified as a supplement in the USA, Australia, and Japan which is referred to as an OTC medicine in Canada (Djaoudene et al., 2023).

Safety and Efficacy

It's impossible to deny the fact that fulfilling research protocols and standard requirements for trials is needed for making the safety and efficacy profile of herbal medicines which is much more difficult compared to Western medicine considering the extrinsic factors that are beyond human control such as the environment fluctuations. As an illustration, herbal medicine based upon the ingredients from a single plant may have abundant phytoconstituents, and complex herbal products based on the material from more than one plant is much more difficult to prepare and is a greater challenge if prepared under standard procedures of and protocols as advised by WHO and FDA and the country's national pharmacopeia (van Wyk & Prinsloo, 2020).

Quality Control and Quality Assurance

The raw material needed for the preparation of herbal medicines should be according to the standards set by the quality control department. Intrinsic factors such as the right species and genetic breeding as well as extrinsic factors for instance, seed condition, environmental conditions, and appropriate collection practices are crucial for the standard preparation of every batch of herbal medicine (Ozioma & Chinwe, 2019). For this purpose, the main challenge is to control the factorial fluctuations that are very difficult in performing quality control testing on the raw materials plant medicinal products (Indrayanto et al., 2021). Considering the Good Manufacturing Practices (GMP), authentic characterization of the medicinal plant species, particular storage and suitable cleaning practices for several materials is a crucial necessity for the quality control and assurance of the standard materials (Xu et al., 2019). Moreover, numerous challenges are necessary for the quality control of the finished medicinal products, particularly in combination herbal medicines (Cortés et al., 2019). Besides, the usual requirements and methodology for the quality control of the final herbal medicines are much more complex contrary to the usual pharmaceutical products (Balekundri & Mannur, 2020). To attain the utmost safety, efficacy, and quality assurance, WHO is constantly standing up for the implication of quality control measures such as National quality Specifications of the raw materials, preparations, packaging, labeling, and licensing plans for the manufacturing process (Fitzgerald et al., 2020).

Safety Monitoring Strategies

Ever since the use of herbal products has extended in developed countries, several issues related to the ambiguous details about safety, efficacy, and interactions of herbal medicines with food or other occidental or herbal products have resurfaced (Fitzgerald et al., 2020). Also, the extensive

dependence of most people residing in developing countries with poor or average economies on crude plants, their extracts, or herbal remedies has raised major concerns regarding the safety profile of these products, for creating the standard herbal drugs as per international standards and for its proper integration into the conventional healthcare system (Raclariu-Manolică et al., 2023). Long-standing adverse effects and short-term side effects induced due to administration of the plant medicines can be accredited to numerous reasons such as substandard preparation or adulteration, unsure therapeutic dose or dosage regimen which may lead to the dosage, using the wrong plant species or growing the right specie under wrong environmental conditions (Klein-Junior et al., 2021). Covering the huge informational gap related to each herbal drug poses severe challenges for the manufacturers in claiming that their products are completely safe and have adequate therapeutic windows or doses reported in pharmacopeias (Choudhury et al., 2023). To overcome such confusion regarding prescription and dosing errors, there is a dire need to adopt the binomial naming system for plants (Wei et al., 2020). Such as *Artemisia absinthium L.*, a plant possessing active narcotic phytochemical has more than 10 common names which can create confusion in various regions depending upon its varied common names in respective regions. Therefore, proper monitoring of the plasma concentrations of the drug and its metabolites is required to overcome this challenge (Barkat et al., 2021).

CONCLUSION

Herbal therapy has advantages and disadvantages in contemporary healthcare, particularly in terms of evidence-based practice. Herbs including Ginseing, *Chamomile*, and *W. coagulans* have for some time been utilized for therapeutic purposes, as upheld by recounted proof and conventional practices. The vast majority believe these plants to be protected, regular options in contrast to customary medicine, or as an enhancement to it. Numerous people like the stimulating impacts of Ginseing, the quieting impacts of *Chamomile*, and the possible advantages of the plant *W. coagulans* for overseeing diabetes and irritation. By the by, much more work should be finished before these plants can be completely incorporated into conventional medication. The essential boundary is the absence of solid clinical confirmation, which is vital for rehearses that are proof-based and reinforce the security and adequacy of these mediations. The requirement for uniform measurement and expected communications with conventional prescriptions are further issues. Moreover, there can periodically be a correspondence breakdown among patients and clinical experts regarding how to appropriately control homegrown prescriptions, which could prompt not great results.

REFERENCES

- Abdallah EM, BY Alhatlani, R de Paula Menezes et al., 2023. Back to Nature: Medicinal plants as promising sources for antibacterial drugs in the post-antibiotic era. *Plants* 12:1-27. <https://doi.org/10.3390/plants12173077>
- Alexieva IN, AT Popova & DS Mihaylova, 2020. Trends in herbal usage-a survey study. *Food Research* 4:500-6. [https://doi.org/10.26656/fr.2017.4\(2\).346](https://doi.org/10.26656/fr.2017.4(2).346)
- Atmakuri LR & Dathi, 2010. Current trends in herbal medicines. *Journal of Pharmacy Research* 3:109-13.

- Balekundri A & V Mannur, 2020. Quality control of the traditional herbs and herbal products: A review. *Future Journal of Pharmaceutical Sciences* 6:1-9. <https://doi.org/10.1186/s43094-020-00091-5>
- Barkat MA, A Goyal, HA Barkat et al., 2021. Herbal medicine: Clinical perspective and regulatory status. *Combinatorial Chemistry & High Throughput Screening* 24:1573-82. <https://doi.org/10.2174/1386207323999201110192942>
- Bhattacharjee B, K Sandhanam, S Ghose et al., 2024. Market overview of herbal medicines for lifestyle diseases. In: *Role of Herbal Medicines* (Dhara AK & SC Mandal, eds): Springer, Singapore, pp. 597-614. https://doi.org/10.1007/978-981-99-7703-1_30
- Briggs AM, J Shiffman, YR Shawar et al., 2020. Global health policy in the 21st century: Challenges and opportunities to arrest the global disability burden from musculoskeletal health conditions. *Best Practice & Research Clinical Rheumatology* 34:101549. <https://doi.org/10.1016/j.berh.2020.101549>
- Chan K, 2016. The evolutionary development of traditional Chinese medicine (TCM) outside the Chinese Mainland: Challenges, training, practice, research, and future development. *World Journal of Traditional Chinese Medicine* 2:6-28. <https://doi.org/10.15806/j.issn.2311-8571.2016.0026>
- Choudhury A, PA Singh, N Bajwa et al., 2023. Pharmacovigilance of herbal medicines: Concerns and future prospects. *Journal of Ethnopharmacology* 309:116383. <https://doi.org/10.1016/j.jep.2023.116383>
- Cortés V, J Blasco, N Aleixos et al., 2019. Monitoring strategies for quality control of agricultural products using visible and near-infrared spectroscopy: A review. *Trends in Food Science & Technology* 85:138-48. <https://doi.org/10.1016/j.tifs.2019.01.015>
- Dai YL, Y Li, Q Wang et al., 2022. Chamomile: a review of its traditional uses, chemical constituents, pharmacological activities and quality control studies. *Molecules* 28:133. <https://doi.org/10.3390/molecules28010133>
- Djaoudene O, A Romano, YD Bradai et al., 2023. A global overview of dietary supplements: Regulation, market trends, usage during the COVID-19 pandemic, and health effects. *Nutrients* 15:3320. <https://doi.org/10.3390/nu15153320>
- El Mihaoui A, EH Erbiai, S Charfi et al., 2023. Chemical characterization and several bioactivities of *Cladanthus mixtus* from Morocco. *Molecules* 28:3196. <https://doi.org/10.3390/molecules28073196>
- Enioutina EY, ER Salis, KM Job et al., 2017. Herbal Medicines: challenges in the modern world. Part 5. status and current directions of complementary and alternative herbal medicine worldwide. *Expert Review of Clinical Pharmacology* 10:327-38. <https://doi.org/10.1080/17512433.2017.1268917>
- Fitzgerald M, M Heinrich & A Booker, 2020. Medicinal plant analysis: A historical and regional discussion of emergent complex techniques. *Frontiers in Pharmacology* 10:1480. <https://doi.org/10.3389/fphar.2019.01480>
- Flagg AJ, 2021. Traditional and current use of Ginseng. *Nursing Clinics* 56:109-21. <https://doi.org/10.1016/j.cnur.2020.10.011>
- Graham K, HA Banwell, RS Causby et al., 2021. Barriers to and facilitators of endorsement for scheduled medicines in podiatry: a qualitative descriptive study. *Journal of Foot and Ankle Research* 14:1-11. <https://doi.org/10.1186/s13047-021-00457-9>
- Gupta R, T Sonawane & S Pai, 2022. An overview on pharmaceutical properties and biotechnological advancement of *Withania coagulans*. *Advances in Traditional Medicine* 22:673-83. <https://doi.org/10.1007/s13596-021-00558-7>
- Hong H, D Baatar & SG Hwang, 2021. Anticancer activities of ginsenosides, the main active components of Ginseng. *Evidence-Based Complementary and Alternative Medicine* 2021:8858006. <https://doi.org/10.1155/2021/8858006>
- Indrayanto G, GS Putra & F Suhud, 2021. Validation of in-vitro bioassay methods: Application in herbal drug research. *Profiles of Drug Substances, Excipients and Related Methodology* 46:273-307. <https://doi.org/10.1016/bs.podrm.2020.07.005>
- Irfan M, YS Kwak, CK Han et al., 2020. Adaptogenic effects of Panax ginseng on modulation of cardiovascular functions. *Journal of Ginseng Research* 44:538-43. <https://doi.org/10.1016/j.jgr.2020.03.001>
- Jacob DE, IU Nelson & SC Izah, 2024. Healing Trails: Integrating Medicinal Plant Walks into Recreational Development. In: *Herbal Medicine Phytochemistry. Reference Series in Phytochemistry* (Izah SC, MC Ogwu & M Akram, eds): Springer, New York, USA, pp. 2049-102. https://doi.org/10.1007/978-3-031-43199-9_68
- Jansen C, JD Baker, E Kodaira et al., 2021. Medicine in motion: Opportunities, challenges and data analytics-based solutions for traditional medicine integration into western medical practice. *Journal of Ethnopharmacology* 267:113477. <https://doi.org/10.1016/j.jep.2020.113477>
- Karmazyn M & XT Gan, 2021. Chemical components of Ginseng, their biotransformation products and their potential as treatment of hypertension. *Molecular and Cellular Biochemistry* 476:333-47. <https://doi.org/10.1007/s11010-020-03910-8>
- Khan MI, M Maqsood, RA Saeed et al., 2021. Phytochemistry, food application, and therapeutic potential of the medicinal plant (*Withania coagulans*): A review. *Molecules* 26:6881. <https://doi.org/10.3390/molecules26226881>
- Kim HJ, TK Oh, YH Kim et al., 2022. Pharmacokinetics of ginsenoside Rb1, Rg3, Rk1, Rg5, F2, and compound K from red Ginseng extract in healthy Korean volunteers. *Evidence-Based Complementary and Alternative Medicine* 2022:8427519. <https://doi.org/10.1155/2022/8427519>
- Klein-Junior LC, MR de Souza, J Viane et al., 2021. Quality control of herbal medicines: From traditional techniques to state-of-the-art approaches. *Planta Medica* 87:964-88. <https://doi.org/10.1055/a-1529-8339>
- Knoess W & J Wiesner, 2019. The globalization of traditional medicines: Perspectives related to the European Union regulatory environment. *Engineering* 5:22-31. <https://doi.org/10.1016/j.eng.2018.11.012>
- Kumar V, 2009. An overview of herbal medicine. *International Journal of Pharmaceutical Sciences* 1:1-20.
- Leichtweis J, Y Vieira, N Welter et al., 2022. A review of the occurrence, disposal, determination, toxicity and remediation technologies of the tetracycline antibiotic. *Process Safety and Environmental Protection* 160:25-40. <https://doi.org/10.1016/j.psep.2022.01.085>
- Liu H, X Lu, Y Hu et al., 2020. Chemical constituents of Panax ginseng and Panax notoginseng explain why they differ in therapeutic efficacy. *Pharmacological Research* 161:105263. <https://doi.org/10.1016/j.phrs.2020.105263>
- Mao JJ, GG Pillai, CJ Andrade et al., 2022. Integrative oncology: Addressing the global challenges of cancer prevention and treatment. *CA: A Cancer Journal for Clinicians* 72:144-64. <https://doi.org/10.3322/caac.21706>
- Mirzaeian R, F Sadoughi, S Tahmasebian et al., 2019. Progresses and challenges in the traditional medicine information system: A systematic review. *Journal of Pharmacy and Pharmacognosy Research* 7:246-59. https://doi.org/10.56499/jppres19.662_7.4.246
- Ni B, X Song, B Shi et al., 2022. Research progress of Ginseng in the treatment of gastrointestinal cancers. *Frontiers in Pharmacology* 13:1036498. <https://doi.org/10.3389/fphar.2022.1036498>
- Nichols MA, SJ Arnett, B Fa et al., 2021. National survey identifying community pharmacist preceptors' experience, knowledge, attitudes, and behaviors influencing intent to recommend cannabidiol products. *Journal of the American Pharmacists Association* 61:S91-S104. <https://doi.org/10.1016/j.japh.2021.01.016>
- Obahiagbon EG & Ogwu, 2024. Consumer perception and demand for sustainable herbal medicine products and market. In: *Herbal Medicine Phytochemistry. Reference Series in Phytochemistry* (Izah SC, MC Ogwu & M Akram, eds): Springer, New York, USA, pp. 1-34. https://doi.org/10.1007/978-3-031-21973-3_65-1
- Ozioma EOJ & OAN Chinwe, 2019. Herbal medicines in African traditional medicine. *Herbal Medicine* 10:191-214.
- Panossian AG, T Efferth, AN Shikov et al., 2021. Evolution of the adaptogenic concept from traditional use to medical systems: Pharmacology of stress- and aging-related diseases. *Medicinal Research Reviews* 41:630-703. <https://doi.org/10.1002/med.21743>
- Parveen B, A Parveen, R Parveen et al., 2020. Challenges and opportunities for traditional herbal medicine today, with special reference to its status in India. *Annals of Phytomedicine* 9:97-112. <https://doi.org/10.21276/ap.2020.9.2.8>
- Raclariu-Manolică AC, Q Mauvisseau & HJ de Boer, 2023. Horizon scan of DNA-based methods for quality control and monitoring of herbal preparations. *Frontiers in Pharmacology* 14:1179099. <https://doi.org/10.3389/fphar.2023.1179099>
- Saggar S, PA Mir, N Kumar et al., 2022. Traditional and herbal medicines: opportunities and challenges. *Pharmacognosy Research* 14:107-14. <https://doi.org/10.5530/pres.14.2.15>
- Sah A, PP Naseef, MS Kuruniyan et al., 2022. A comprehensive study of therapeutic applications of Chamomile. *Pharmaceuticals* 15:1284. <https://doi.org/10.3390/ph15101284>
- Sharma Y, 2021. Consumer Behavior towards Herbal Medicine and Practices (Survey). *Journal of US-China Medical Science* 18:37-56. <https://doi.org/10.17265/1548-6648/2021.01.004>
- Shiffman J, 2017. Four challenges that global health networks face. *International Journal of Health Policy and Management* 6:183. <https://doi.org/10.15171/ijhpm.2017.14>
- Stéphane FFY, BKJ Jules, GES Batiha et al., 2021. Extraction of bioactive compounds from medicinal plants and herbs. *Natural Medicinal Plants* 27:1-39.

- Tahir T, M Javed, W Ahmed et al., 2024. Therapeutic uses and pharmacological properties of the traditional South Asian medicinal plant *Withania coagulans* (Stocks) Dunal. Journal of Herbal Medicine 31:100926. <https://doi.org/10.1016/j.hermed.2024.100926>
- van Wyk AS, & G Prinsloo, 2020. Health, safety and quality concerns of plant-based traditional medicines and herbal remedies. South African Journal of Botany 133:54-62. <https://doi.org/10.1016/j.sajb.2020.06.031>
- Vickers A & C Zollman, 1999. ABC of complementary medicine: Herbal medicine. British Medical Journal 319:1050. <https://doi.org/10.1136/bmj.319.7216.1050>
- Wang YK, WQ Li, S Xia et al., 2021. Metabolic activation of the toxic natural products from herbal and dietary supplements leading to toxicities. Frontiers in Pharmacology 12:758468. <https://doi.org/10.3389/fphar.2021.758468>
- Wei XC, B Cao, C Luo et al., 2020. Recent advances of novel technologies for quality consistency assessment of natural herbal medicines and preparations. Chinese Medicine 15:1-24. <https://doi.org/10.1186/s13020-020-00335-9>
- Williamson EM, X Liu & AA Izzo, 2020. Trends in use, pharmacology, and clinical applications of emerging herbal nutraceuticals. British Journal of Pharmacology 177:1227-40. <https://doi.org/10.1111/bph.14943>
- Xiong Y, M Li, P Sun et al., 2022. Market access for Chinese herbal medicinal products in Europe-A ten-year review of relevant products, policies, and challenges. Phytomedicine 103:154237. <https://doi.org/10.1016/j.phymed.2022.154237>
- Xu HY, YQ Zhang, ZM Liu et al., 2019. ETCM: an encyclopaedia of traditional Chinese medicine. Nucleic Acids Research 47:976-82. <https://doi.org/10.1093/nar/gky987>
- Yadav N, S Singh Chandel, T Venkatachalam et al., 2024. Herbal medicine formulation, standardization, and commercialization challenges and sustainable strategies for improvement. In: Herbal Medicine Phytochemistry. Reference Series in Phytochemistry (Izah SC, MC Ogwu & M Akram, eds): Springer, New York, USA, pp. 1769-95. https://doi.org/10.1007/978-3-031-43199-9_40
- Zhou X, CG Li, D Chang et al., 2019. Current status and major challenges to the safety and efficacy presented by Chinese herbal medicine. Medicines 6:14. <https://doi.org/10.3390/medicines6010014>