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# Herbal Medicines and Dietary Supplements: A Comprehensive Review

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**ABSTRACT**

For millennia, people from diverse cultures have used dietary supplements and herbal medicines as health and wellness solutions. Growing awareness of these natural medicines' potential advantages and a desire for alternate approaches to healthcare have led to a resurgence of interest in them in recent decades. A thorough summary of herbal remedies and dietary supplements is given in this review article, together with information on their historical applications, present-day use, scientific backing, safety concerns, legal environment, and potential future developments. This review attempts to provide healthcare professionals, researchers, and consumers useful insights into the safety, effectiveness, and practical considerations associated with the use of herbal medicines and dietary supplements through a critical examination of the existing literature and research findings.

## 1. Introduction

People have been using plants as medicine for millennia. Throughout history, people have employed plant products, such as food ingredients or botanical potions and powders, to treat and prevent various illnesses, with differing degrees of effectiveness. Archaeological evidence points to even earlier use of medicinal herbs, and written records about them go back at least 5000 years to the Sumerians. With the introduction of synthetic acetyl salicylic acid (aspirin) to the globe in 1897 by Friedrich Bayer & Co., the long-standing association between plants and human health started to erode. Salicylic acid, the main component of willow bark, has a safer synthetic equivalent called aspirin. People in both the Old and New worlds separately found aspirin as a cure for fevers and aches. In more traditional medical terms, herbal medicine refers to the use of plants, plant parts, their water or solvent extracts, essential oils, gums, resins, exudates, or other form of advanced products made from plant parts, therapeutically to provide proactive support of various physiological systems.

According to the World Health Organization, between 70 and 80 % of the world's population, especially in developing nations, receives their primary care from non-conventional medicine. Growing interest has been seen in natural products, particularly those produced from plants, and alternative medicines in recent years. The interest in drugs derived from plants stems from a number of factors, including 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 lead to side effects and other issues, that a significant portion of the global population lacks access to conventional pharmaceutical treatment, and that natural products are harmless according to folk medicine and ecological awareness. The use of these chemicals is not usually permitted by regulatory bodies that oversee safety and efficacy protocols, and numerous published studies highlight the poor quality of phytomedicinal product manufacturing, distribution, and prescription practices. Approximately 25% of pharmaceuticals prescribed globally are derived from plants, with 121 active chemicals being used currently. Of the 252 medications that the World Health Organization (WHO) lists as basic and essential, just 11% are derived solely from plants, and a sizable portion are synthetic medications made from natural precursors. Digoxin from Digitalis spp., quinine and quinidine from Cinchona spp., vincristrine and vinblastine from Catharanthus roseus, atropine from Atropa belladonna, and morphine and codeine from Papaver somniferum are a few notable examples of significant medications derived from plants.

India has a long history of cultural diversity and vibrancy. The concept of health and healing is important to this culture and heritage. As a result, all ethnic communities throughout the various ecosystems have access to a vast body of information about health and healing. Unfortunately, for the past few centuries, the mainstream culture has had a greater influence on this body of knowledge, diluting the importance of regional health customs. Effective recording and assessment procedures must be implemented immediately to revive local health customs; else, this magnificent people's health culture would be lost forever. This nation is appropriately referred to as the "botanical garden of the world" since it is arguably the world's largest grower of therapeutic herbs. There aren't many significant therapeutic herbs that are not available in this nation. More than 3000 plants are officially recognized as having therapeutic use in India. Around 6000 plants are thought to be used in traditional, folk, and herbal medicine in India; this amount roughly corresponds to 75% of the Third World's medical needs. An estimated 7800 medical medicine production facilities exist in India, and these facilities are thought to use 2,000 tons of herbs a year on average. India is home to three of the ten herbal medications that are most popular in developed nations: Allium sativum, Aloe arbedensis, and Panax sp. formulations. Approximately 7000 businesses produce traditional medications, either with or without standardization.

## 2. Classification And Types Of Herbal Medicines And Dietary Supplements

| **Country** | **Regulatory Agency** | **Classified as Supplements** | **Classified as Medicines** |
|---|---|---|---|
| USA | Food and Drug Administration (FDA) | **Dietary Supplement - Centre for Food Safety and Applied Nutrition (CFASN)/FDA**<br>• Herbs/Botanicals<br>• Vitamin<br>• Minerals<br>• Amino Acids<br>• Dietary substance for use by man to supplement the diet by increasing the total intake<br>• Concentrate, metabolite, constituent, extract or combination of the preceding substances. | **Botanical drugs - Centre for Drug Evaluation and Research (CDER)/FDA** |
| Australia | Therapeutic Goods Administration (TGA) | | **Complementary Medicines - Complementary and OTC Medicines Branch/TGA**<br>• •Herbs<br>• •Vitamin<br>• •Minerals<br>• •Nutritional supplements<br>• •Homeopathy<br>• •Microorganism (whole extracted) etc. |
| Australia | Food Standards Australia New Zealand (FSANZ) | **Novel Food**<br>• •Foods and extracts from plants, animals, etc.,<br>• •Foods and their extracts resulting from production processes and practices, and new technologies. | |
| New Zealand | New Zealand Ministry for Primary Industries (MPI) | **Supplemented food**<br>• •Foods modified or with added substances so that they perform a physiological role | |
| New Zealand | New Zealand Medicines and Medical Devices Safety Authority (Medsafe) | **Dietary supplements** | **Herbal Remedies** |
| New Zealand | Food Standards Australia New Zealand (FSANZ) | **Novel Food**<br>• •foods and extracts from plants, animals, etc., | |

| | | | |
|---|---|---|---|
| | | • Foods and their extracts resulting from production processes and practices, and new technologies. | |
| Canada | Health Canada (HC) | | **Natural Health Products**<br>• Traditional medicine<br>• Herbal Medicine<br>• Homeopathy |
| China | China Food and Drug Administration (CFDA) | Health foods | Traditional Chinese Medicine |
| Japan | Ministry of Health, Labor and Welfare (MHLW) for Medicines<br>Consumer Affairs Agency (CAA) for Supplements | Health foods | **Kampo Medicine** |
| EU | European Medicines Agency (EMA) | | **Herbal Medicinal Products**<br>National competent authorities of EU Member States |
| EU Member States | National competent authorities<br>European Food Safety Authority (EFSA) if centralized procedures apply | Substances with a nutritional or physiological effect (vitamins, minerals, botanicals, etc.) | |

## 3. Specific Mechanisms of Action of Herbal Remedies

### *3.1 Adaptogens*

An adaptogen is a chemical derived from plants that helps people cope better with stress, trauma, anxiety, and exhaustion. Herbalists use the phrase to describe plants that are more commonly referred to as tonics, or substances that have a revitalizing effect. [16] It comprises rasayanas in Ayurvedic medicine, Q tonics in Chinese herbal medicine, and multi-herb restoratives in Tibb medicine. Traditional medical practices have traditionally used adaptogen-rich plants as tonics, such as ginseng and licorice.

Separately, a class of adaptogenic herbal products known as immune-modulators can both stimulate the immune system to combat infection and cancer and reduce the immune processes that exacerbate inflammation in wounds and other injuries.

#### *3.1.1. Mechanism of Action*

Adaptogens have the ability to either accelerate or decrease a variety of bodily processes, based on the demands of the moment. They support the preservation or restoration of the body's homeostatic state by serving as metabolic checks and balances. They accomplish this by affecting the endocrine and immunological systems, which helps the body regain balance when certain illnesses cause disruptions. After being absorbed by the body, the active components in the herbs have the ability to pass across cell membranes. Certain entities possess the ability to migrate and subsequently adhere to the nucleus' DNA. This interaction results in altered hormone secretion and nervous system message transmission. The endocrine system also regulates the release of hormones. Polysaccharides are the structural building blocks of some adaptogens. Others are phytosterols, or plant sterols, derived from sitosterol, a steroid that is comparable to human cholesterol. Generally speaking, adaptogens seem to have anti-oxidant properties that reduce the negative effects of oxidative species and free radicals on the body's metabolic functions.

### *3.2. Anti-inflammatory Agents*

Part of a complicated biological process, inflammation attempts to return the body to homeostasis after it has been upset by pathogenic microorganisms, chemical irritants, physical trauma, or damaged tissues. It is arguably the primary defense system in the body and collaborates closely with the immune system to suppress pathogenic activity and start the healing process. Through interactions with the neurological and endocrine systems, it is modulated. Corticosteroids and nonsteroidal anti-inflammatory medications (NSAIDs) are used in conventional pharmacological therapy. The former group functions by inhibiting two enzymes: prostaglandin synthetase, which is involved in inflammation signs and symptoms, and cyclo-oxygenase, which relieves pain. Corticosteroids function by binding to cytoplasmic steroid receptors in cells and then activating the nucleic acids.

Long-term NSAID use can cause erosions of the stomach lining, which frequently result in severe ulcers and perforations that pose a major risk to life. The elderly are more susceptible to hazardous medication reactions, as they are often the age group most afflicted by inflammatory diseases like arthritis. NSAIDs may also raise the risk of asthma episodes and renal impairment. Since inflammation is a necessary component of the healing process, fully inhibiting it will not have any positive clinical effects. In an attempt to reduce inflammation symptoms, exogenous corticosteroids and traditional NSAIDs frequently result in the complete shutdown of a healing process.

A patient experiencing a severe or ongoing inflammatory response requires careful process modulation and control. This can be obtained from a number of plants without causing the negative pharmacological effects that sometimes accompany traditional anti-inflammatory medications. Turmeric, hyssop, arnica, and ginger are known to contain helenalin, an inflammatory agent. Many botanicals, including willow bark, contain salicylic acid, another anti-inflammatory ingredient. The successful use of cannabinoids to treat unresponsive inflammation and intractable pain is growing.

### *3.3. Nitric Oxide Synthesis Modulators*

Highly reactive free radical nitric oxide (NO) is important in immune system and muscle function. It is a crucial messenger that is involved in a number of biological reactions. Numerous illnesses, particularly those affecting the heart and blood circulation, are also linked to it. It is a straightforward gaseous chemical that was formerly known as the endothelium derived relaxing factor. It is produced in the body when the enzyme nitric oxide synthase catalyzes the metabolic reaction of oxygen with the amino acid arginine.

#### *3.3.1 Herbs and Nitric Oxide*

Numerous herbs have the ability to produce more NO, and these are frequently utilized to treat cardiovascular conditions. The activation of macrophages is one reaction. These scavenger cells, which are found in many organs, take up and break down invasive microorganisms. By raising NO levels in vascular tissue, some herbs function as vasodilators. For instance, it is known that the ginsenosides, or saponins, from ginseng, relax blood arteries. This most likely plays a part in ginseng's ability to reduce blood pressure and weariness. Furthermore, it has been demonstrated that ginkgo and hawthorn herbal preparations influence endothelial NO production. A traditional tonic plant called safed musli helps animals reproduce by promoting the synthesis of NO.

Platelet-activating factor (PAF), a mediator of inflammation, several leucocyte functions, platelet activity, and a direct cause of asthma and other allergies, is how gingko biloba works. Additionally, it contributes to the anaphylactic reaction. By inducing smooth muscle relaxation through the stimulation of prostacyclin and endothelium-derived growth factor, PAF directly affects vascular smooth muscle. Dilated arteries and arterioles to and within the lung, as well as the rest of the body, increase blood flow and improve the delivery of oxygen and glucose to tissues. This is the overall result. Asthma and other allergy-related respiratory disorders are linked to bronchiolar constriction, which G. biloba is claimed to effectively relieve. It also inhibits the enzymes involved in smooth muscle relaxation.

### *3.4. Micro-nutrients*

The broad word for vitamins, vital fatty acids, amino acids, microminerals, and trace elements is a micronutrient. Their function in the body is to help the enzyme systems that already exist work more effectively, not to produce energy or construct tissues. The metallic elements iron, chromium, zinc, copper, cobalt, manganese, and molybdenum are comprised of micro-minerals.

Micronutrients also offer defense against environmental pollutants, which can be harmful to the body over time if exposed to them. The body systems experience distress when an important nutrient is either absent from the diet, insufficient, or too weak to maintain the natural equilibrium inside the body. Other organs are affected by this, throwing the body's equilibrium off-kilter.Numerous nutritional components can be found in herbal products, including vitamins (particularly the water soluble B complex), minerals (like potassium), and trace elements (including molybdenum, zinc, and cobalt). These could help the patient's chronic deficiency diseases get better. The individual's well-being may be disproportionately affected by symptoms that may be minimal. Aminopeptidase, phosphodiesterase, and alcohol dehydrogenase, for instance, all require zinc in order to function. In addition to being a crucial co-factor for a number of enzymes involved in the mitochondria's energy production, iron is also a necessary part of non-enzyme proteins like cytochrome and hemoglobin.

Micro-minerals are present in many herbal treatments and may be responsible for the tonic effect reported. Naturally, this reaction depends on the kind and concentration of the micromineral as well as the underlying condition that the patient is exhibiting. Certain herbal preparations frequently include vitamins, albeit in trace amounts. Numerous goods contain vitamin C, which helps the body absorb dietary iron and lowers the risk of iron-deficiency

anemia. On the other hand, the ingredients in the herbal product might help the body absorb certain vitamins from supplements or the food. Certain herbal preparations contain two flavonoid glycosides called rutin and hesperidin, which aid in the digestive tract's absorption of vitamin C.

## 4. Quality control of Herbal Medicine

The biological activity and composition uniformity of medicinal medications are necessary for their safe and effective administration. One of the most important factors in establishing the safety and efficacy of botanical treatments is quality, which refers to techniques and indicators for assessing and verifying the strength of botanical raw materials, extracts, or formulations thereof. However, botanical preparations are rarely up to the required standards of excellence.

Nowadays, one or two markers or pharmacologically active ingredients in herbs and/or herbal mixtures are typically used to evaluate the quality and authenticity of herbal medicines, the identification of specific herbs or herbal medicine preparations, and the quantitative herbal composition of a herbal product. However, because the medicinal benefits of a herbal product are usually ascribed to multiple factors, this kind of analysis does not give a complete picture of the product. These various parts are seldom distinguishable from one another and may work together. Furthermore, a number of factors, including harvest seasons, plant origins, and drying techniques, may alter the chemical composition of the herbs that make up the herbal medicine products.

Consequently, it seems that determining the bulk of the phytochemical components present in herbal products is crucial for enhancing product quality control, comprehending the bioactivities and possible adverse effects of the active ingredients, and guaranteeing the reliability and consistency of pharmacological and clinical research.

Herbal medicine quality control techniques include sensory inspection (both macroscopic and microscopic analyses). Shape, size, color, texture, surface features, fracture characteristics, taste, smell, and other organoleptic attributes are some of the elements that determine a botanical material's macroscopic identification when compared to a standard reference material. In microscopy, broken as well as powdered, crude, botanical materials are inspected under a microscope in comparison, and analytical inspection is conducted using instrumental techniques such near infrared (NIR), spectrophotometer, thin layer chromatography, GC-MS, LC-MS, and thin layer chromatography. All herbal medicines and their extracts, however, contain hundreds of unidentified ingredients, many of which are present in trace amounts. Furthermore, variations may occur even within the same botanical ingredients. As a result, it is not simple or unimportant job to obtain trustworthy chromatographic fingerprints that reflect pharmacologically active and chemically distinctive components. Thankfully, chromatography has very strong separation capabilities, allowing complicated chemical components in extracts of herbal medicines to be broken down into numerous, relatively simple subfractions. Additionally, newer methods of hyphenated chromatography and spectrometry application, like capillary electrophoresis-diode array detection (CE-DAD), gas chromatography-mass spectroscopy (GC-MS), high-performance liquid chromatography-diode array detection (HPLC-DAD), HPLC-MS, and HPLC-NMR, may be able to offer additional spectral information. This information will be very beneficial for qualitative analysis and even for real-time structural clarification. The spectrum information enables the hyphenated instruments to perform significantly better in terms of selectivity, chromatographic separation capabilities, measurement precision, retention time shift correction, and the removal of instrumental interferences. Clear images for the chromatographic fingerprints obtained may be produced if hyphenated chromatography is further integrated with chemometric techniques. Hyphenated chromatography will yield a chemical fingerprint that serves as the main instrument for herbal medicine quality monitoring. The challenge of assessing the integrated sameness and/or difference and managing their stability of the available herbal goods is the only one that can be solved by employing chemical fingerprints for quality control of herbal medications.

## 5. Current Status Of Herbal Drugs

Recently, the World Health Organization's executive board endorsed a resolution urging nations:

1) To encourage the use of traditional healers in developing nations' healthcare systems; &

2) To increase funding for the advancement of conventional medical systems.

The medical community was also advised by the board to respect the established medical system. WHO acknowledges that two thirds of babies born worldwide are delivered by traditional birth attendants and that the bulk of the world's impoverished population lacks access to modern medical treatment. To meet everyone on the planet's fundamental health needs, both the Western and traditional medical systems will need to be used. Some countries—China, India, and Sri Lanka, for example—have legal recognition for their traditional medical practices. Traditional practitioners also advise employing such medical herbs and medications to treat their patients efficiently. A few examples of these plants are the Mediterranean herb Ammi visnage, which is used to treat angina pectoris; the Egyptian plant Cymbopogan proximus, which is used to remove urinary tract stones; the root of the copetum plant, which is used to treat guinea worms in Ghana; bitter leaf, a Nigerian plant that kills mouth bacteria; and Thonningia sanguinea and Deinbollia pinnata, which are used in different combinations to treat bronchial asthma.

One of the first goals of the World Health Organization's (WHO) initiative on traditional medicine was to encourage a practical approach to the topic. There appears to be progress being made in this direction, based on the realistic examination of traditional traditions by developed and developing nations alike. Pursuing action along three lines evaluation, integration, and training is the current challenge. In traditional medicine, it's important to discern between fact and fiction in order to distinguish between safe and/or successful methods and cures.

WHO will therefore keep pushing for the creation, dissemination, and use of analytical techniques that may be applied to assess the efficacy and safety of different components of conventional medicine. Training is also necessary for traditional practitioners. They require the acquisition of new abilities. It's critical to view traditional medicine practitioners as allies rather than rivals. One excellent illustration of the potential for cooperation between the traditional and modern health care sectors is the training of traditional birth attendants in aseptic delivery techniques and basic prenatal and postpartum care. The WHO has conducted a number of initiatives in the area of traditional medicine within the last two years.

Medicinal plants have been utilized for thousands of years. Approximately 35,000 of the estimated 2,50,000–3,50,000 plant species that have been identified to date are utilized medicinally in different parts of the world. The WHO has proven that around 80% of the world's population can get the health care they need from herbal medicines; this is especially true for the millions of people who live in the vast rural areas of developing nations. Consumers in affluent nations are looking for alternatives as they grow disenchanted with contemporary healthcare. The efficiency of plant medicines, the adverse effects of most modern medications, and the advancement of science and technology are the main causes of the current spike in popularity of plant therapies. Around 200 businesses and research institutions worldwide are reportedly screening plant and animal chemicals for therapeutic qualities as of the mid-1990s. In actuality, a number of significant pharmaceuticals utilized in contemporary medicine—such as vinblastine, vincristine, topotecan, irinotecan, etoposide, teniposide, and taxol/paclitaxel—have originated from investigations on medicinal plants. Several universities have reported on novel discoveries about the phytochemical and pharmacological properties of medications obtained from orchids. There aren't many research done on plants, though. Of the approximately one million species of higher plants, only around one-third have been named and identified by scientists. Just a small portion of the names have been researched. These days, a novel method that links traditional knowledge of medicinal plants to contemporary research endeavors improves the rate of medication discovery significantly above random collection.

## 6. Future Prospects In Herbal Medicines:

Currently, the majority of scientific study on medicinal plants is conducted in universities, research institutes, pharmaceutical labs, and clinics across many wealthy nations. The primary focus of this research are two. First, research is done on the active components of plants that have long been associated with healing. The quest for previously undiscovered new species of medicinal plants and pharmaceuticals

from the world's more isolated locations is the focus of the second area of fundamental research.

All traditional medicines, including those from Ayurveda, Unani, and Siddha, must have scientific testing and validation. About 350 formulations for various activities have already been validated by the Council for Scientific and Industrial Research (CSIR), New Delhi, which is actively active in this field. This is a positive trend that aims to improve health by fusing ancient methods with newfound information. The WHO has underlined how important it is to use contemporary methods to guarantee quality control of herbs and herbal mixtures. To preserve the quality of their herbal products, several nations establish monographs and pharmacopoeias. The Indian Ayurvedic Pharmacopoeia offers fundamental quality standards for eighty commonly used herbal medications.

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