University Of Salahaddin – Erbil

Herbal medicine in terms of sciences

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Superviser's Certification

Research has been written under my supervision and has been submitted for the award of the degree of bachelors of Science in Biology with my approval as supervisor.

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Abstract

Herbal medicine represents a rich source of bioactive compounds with significant therapeutic potential. In this research, we specifically focus on herbal medicine in terms of sciences, highlighting its Primary and Secondary metabolites, Natural or herbal medicine definition, the History of natural medicine, According to WHO, NCCIH, According FDA, Botanical uses in modern drug development, Advantages and Disadvantages of herbal medicine, Plant parts used for herbal medicine and Dosage forms of herbal medicines, Use of medical plant products, and Conclusions. The utilization of plant-derived compounds and the conservation of medicinal plants are essential for promoting human health and well-being.

Keywords: medicinal plants, herbal medicine, herbal products

1. Introduction:

Herbal medicine, also known as botanical medicine or phytotherapy, has been an integral part of human healthcare for centuries. It involves the use of plants and plant extracts for medicinal purposes. The use of herbal remedies is deeply rooted in traditional and indigenous medical practices and has gained recognition in modern scientific research. The therapeutic potential of medicinal plants has been extensively documented, and their significance in drug discovery and development is well established (Atanasov et al., 2015). Herbal medicine is not merely a placebo but a rational form of medicine, as evidenced by the proven efficacy of several herbal remedies in clinical trials (Wink, 2015). The World Health Organization estimates that over 65% of the world's population relies solely on botanical preparations for their medicinal needs (Lowe et al., 2021). Herbal medicines currently serve the health needs of approximately 80% of the world's population, especially in rural areas of developing countries (Li et al., 2020). The pharmacological value of medicinal plants is evident from their historical use as sources of therapeutic molecules and their continued importance in identifying novel drug leads (Atanasov et al., 2015). The potential of phytochemicals derived from herbal medicines, such as quercetin, curcumin, and catechins, in cancer treatment and protection against chemotherapy side effects has been a subject of extensive research (Jain et al., 2021). the use of botanical drugs in traditional Chinese medicine emphasizes the symptom characteristics of the population, highlighting the rational approach to herbal medicine in addressing specific health conditions (Huan et al., 2023).

The scientific exploration of herbal medicine extends to the evaluation of its biological activities, safety, and potential side effects. Efforts to monitor and regulate herbal drugs and traditional medicine are underway, emphasizing the need for rigorous scientific scrutiny of herbal remedies (Patwardhan et al., 2005). Furthermore, the assessment of the antioxidant, anti-genotoxic, anti-tumoral, and immunomodulatory effects of plant extracts underscores the scientific rigor applied to the study of herbal medicine (Horchani et al., 2021). However, despite the promising therapeutic potential of herbal medicine, there are specific challenges in conducting clinical trials to evaluate the medicinal effects of botanicals, which require attention to ensure relevance, rigor, and reproducibility (Funk & Schneider, 2021).

1.1. Primary and secondary metabolites

Metabolites are essential molecules in living organisms, classified into primary metabolites, crucial for basic functions, and secondary metabolites, which play important ecological and medicinal roles (Armarkar et al., 2021). In the context of herbal medicine, secondary metabolites are crucial, as they contribute to the therapeutic properties of herbal medicines (Ginwala et al., 2019). Herbal medicines contain a diverse range of secondary metabolites such as alkaloids, flavonoids, glycosides, terpenoids, and phenolic compounds, which are responsible for their characteristic flavors, scents, and medicinal value (Ginwala et al., 2019). These compounds also serve as chemical defense mechanisms in plants (Ginwala et al., 2019). The therapeutic efficacy of herbal medicines is closely linked to the presence of these secondary metabolites, which have been found to possess immunomodulatory, antioxidant, and antimicrobial effects (Ginwala et al., 2019; Iitsuka et al., 2018). the production of secondary metabolites in plants is influenced by various factors, including environmental stresses, leading to the synthesis of compounds that function as chemical defense mechanisms (Armarkar et al., 2021). The study of secondary metabolites is essential in natural product chemistry and drug discovery, as these compounds have been identified to possess therapeutic value and are reservoirs of novel therapeutic agents (Armarkar et al., 2021). The identification and quantification of secondary metabolites in medicinal plants are crucial for understanding their pharmacological actions and for quality control purposes (Armarkar et al., 2021).

The diverse chemical nature and biological activities of secondary metabolites make them valuable resources for drug development and highlight the importance of understanding their roles in plant physiology and human health (Armarkar et al., 2021). The presence of secondary metabolites in herbal medicines has been found to regulate intestinal flora dysbiosis, which is an important potential target for the treatment of female reproductive disorders (Liu et al., 2022). The therapeutic potential of herbal medicines is also attributed to the synergistic mechanisms of constituents, including primary and secondary metabolites, which promote their intestinal absorption and bioavailability (Zhao et al., 2020). the immunomodulatory properties of lactic acid bacteria fermented herbal medicines have been found to have a positive impact on the activity of the human gut, further supporting the immune system (Zhu et al., 2022).
secondary metabolites are integral to the therapeutic properties of herbal medicines, and their study is essential for understanding their roles in plant physiology, human health, and drug discovery. The diverse chemical nature and

biological activities of secondary metabolites make them valuable resources for drug development and highlight the importance of their identification, quantification, and study in the context of herbal medicine.

1.2. Natural or herbal medicine definition

Natural or herbal medicine refers to medicinal products made from natural ingredients, such as plants, herbs, or other botanical sources. These products are often used for their perceived health benefits and have been historically utilized in various traditional medicine systems. The European Union has official definitions for terms related to herbal products, including 'herbal substances (or herbal drugs)', 'herbal preparations', and 'herbal medicinal products' (Aronson, J. 2016). Herbal production involves the use of definite ingredients with specific pharmacological effects for medical purposes (Bhatt, S. 2020). These products may include herbal medicines, dietary supplements, and other botanical products, and are often sought after due to cultural acceptability and the belief that being natural makes them safe and non-toxic (Abou-Elella et al., 2016). In the context of modern medicine, natural or herbal medicine is often categorized under complementary and alternative medicine (CAM), which includes natural products, mind-body medicine, movement therapies, manipulative/body therapies, and energy practices (Neuhouser et al., 2016). The use of herbal medicine has also been observed in the context of combating specific health challenges, such as the use of herbal medicine to help combat COVID-19 infection in combination with modern anti-infective agents (Chien et al., 2022).

The term "natural medicine" encompasses medicinal products made from natural ingredients, and the active components of natural medicine refer to definite chemical structures obtained from single natural medicine, compound prescriptions, or extracts (Zhao et al., 2021). Herbal medicines exhibiting adaptogenic qualities have been historically listed as a sub-class within a broader definition of tonics, indicating their potential to support the body's ability to resist stress and restore balance (Gerontakos et al., 2021). Medicinal plants, including herbal medicines, have a long history of use in the treatment of various health conditions, including cancer (Khalek et al., 2015). The use of herbal medicines and dietary supplements is also considered in the context of drug-induced liver injury, highlighting the importance of considering herbal medicines in causality assessment methods (Danan & Teschke, 2019).

Natural or herbal medicine encompasses medicinal products made from natural ingredients, such as plants and herbs, and has been historically utilized in various traditional medicine systems. These products are often sought after due to cultural acceptability and the belief that being natural makes them safe and non-toxic. In the context of modern medicine, herbal medicine is often categorized under complementary and alternative medicine and has been observed in the context of combating specific health challenges. It is important to consider herbal medicines in the assessment of drug-induced liver injury and in the treatment of various health conditions, including cancer.

1.3. History of natural medicine

The history of natural medicine is deeply rooted in the use of medicinal plants and traditional healing practices, which have been prevalent across various cultures and civilizations for centuries. The utilization of natural products and traditional medicine in treating diseases has been a significant aspect of human healthcare throughout history (Ahmed, H. 2016). The use of medicinal plants has been documented in ancient texts and historical records, reflecting the rich knowledge and practices of traditional medicine (Shahriari et al., 2018). Traditional medicine encompasses a wide range of health practices, incorporating plant, animal, and mineral-based medicines, spiritual therapies, manual techniques, and exercises, applied singularly or in combination to treat, diagnose, and prevent illnesses or maintain well-being (Holoff, R. 2021).

The historical significance of natural medicine is evident in the extensive use of traditional medicine in various cultures, such as in India, where traditional medicine has played an essential role in healthcare services and welfare (Adhikari & Paul, 2018). Similarly, in Ethiopia, traditional medicine has maintained its popularity and is utilized by a significant proportion of the population for primary healthcare (Wassie et al., 2015). The preference and practice of traditional medicine are influenced by sociodemographic, economic, cultural, and environmental factors (Chali et al., 2021). The use of traditional medicine is deeply ingrained in the livelihood and practices of indigenous communities, reflecting the ethnobotanical significance and sustainability of traditional medicinal plants in treating non-communicable diseases (Sathiya et al., 2019).

The history of natural medicine in Kurdistan, Iraq, is characterized by a rich diversity of medicinal plants, yet there is a scarcity of ethnobotanical studies available in the scientific literature, highlighting the potential for further exploration of traditional medicine practices (Ahmed, H. 2016). The use of natural

products for medicinal purposes has a long history and has been widely used to treat various acute, chronic, and life-threatening diseases worldwide (Zeng et al., 2022). This is further supported by the discovery of a Neanderthal burial in northern Iraq, dated approximately 60,000 years ago, which provides evidence that herbal medicine has likely been practiced in the mountains and plains of Kurdistan since the dawn of civilization (Amin et al., 2021).

Finally, we do this report to know more about herbal medicine which represents a rich source of bioactive compounds with significant therapeutic potential. The scientific exploration of herbal medicine encompasses various aspects, including its historical significance, biological activities, safety evaluation, and challenges in conducting clinical trials. The rational approach to herbal medicine is evident from its widespread use and the continuous efforts to integrate traditional knowledge with modern scientific methodologies.

2. Results and Discussion:

2.1. According to WHO

Herbal medicine has been a subject of interest for the World Health Organization (WHO) due to its widespread use and potential benefits. The WHO has recognized the importance of herbal medicine and has issued guidelines and recommendations for its use in various contexts. According to Luo et al., the National Health Commission in China has declared the use of herbal medicine combined with Western medicine as a treatment for COVID-19 and has issued guidelines on herbal medicine-related therapies (Tegegne et al., 2022). the WHO estimates that 4 billion people, about 80% of the world's population, use herbal medicine for some aspect of primary health care (Musa et al., 2023). This highlights the significant global reliance on herbal medicine and the need for guidelines to ensure its safe and effective use.

The WHO has emphasized the importance of monitoring the safety of herbal medicines within the current pharmacovigilance framework (Alshakka et al., 2021). This indicates the WHO's commitment to ensuring the safety and quality of herbal medicines through established monitoring processes. the WHO has defined herbal medicines as "herbs, herbal materials, herbal preparations, and finished herbal products that contain as active ingredients parts of plants, or other plant materials, or combinations" (Amorha et al., 2019). This definition reflects the WHO's recognition of the diverse forms of herbal medicines and the need for clear guidelines to regulate their use.

In the context of clinical trials and research, the WHO has played a role in providing quality guidelines for herbal medicine trials. mentioned that the WHO has published recommendations for quality standards and good clinical practice in herbal medicine trials, including WHO recommendations and International Union of Pure and Applied Chemistry (IUPAC) protocols (Tsiogkas et al., 2021). This demonstrates the WHO's efforts to establish standardized practices for conducting herbal medicine trials, ensuring the reliability and validity of research in this field.

Moreover, the WHO has been involved in providing regulatory information on herbal medicinal products to guide evidence-based herbal medicine use (Hoshino et al., 2018). This regulatory information is essential for identifying the research needed to support the safe and effective use of herbal medicines. Additionally, the WHO has been a key player in developing clinical practice guidelines for the use of traditional Chinese herbal medicine, particularly in the context of COVID-19 (Li et al., 2020). This highlights the WHO's engagement in promoting evidence-based practices and ensuring the appropriate use of herbal medicine in response to public health challenges. The WHO has been actively involved in issuing guidelines, recommendations, and regulatory information to support the safe and effective use of herbal medicine. Its efforts encompass various aspects, including safety monitoring, clinical practice guidelines, quality standards for trials, and regulatory guidance. These initiatives reflect the WHO's commitment to promoting evidence-based herbal medicine practices and ensuring the well-being of global populations.

2.2. **According to NCCIH**

The National Center for Complementary and Integrative Health (NCCIH) has categorized complementary and integrative approaches into three main categories: natural products, mind and body practices, and other complementary approaches. Natural products include herbal medicines, botanicals, vitamins, minerals, probiotics, and other dietary supplements. This categorization aligns with the findings of a study in Thailand, which reported a high prevalence (60.8%) of herbal medicine usage among the elderly in a primary care unit (Ananchaisarp et al., 2021). The study also highlighted that one of the main reasons for choosing herbal medicines is their perceived better efficacy and relatively lower side effects compared to conventional drugs.

A study conducted in Indonesia revealed that a significant proportion of medical doctors prescribed herbal medicine as a complement to conventional medicine, and in some cases, as an alternative medicine for patients who felt hopeless about conventional treatments (Delima et al., 2020). This indicates the

growing acceptance and utilization of herbal medicine within the medical community.

However, the increasing use of herbal medicines also raises concerns about potential interactions with prescription medications. Research has shown that approximately one in four people taking prescription medications also takes herbal medicine, and one in three concurrent users is at risk of potential interactions between them (Schiopu et al., 2022). This underscores the importance of involving pharmacists in managing the use of herbal medicines, especially among the elderly, to ensure the safe and effective use of these products.

2.3. According to FDA&ABC&NIH

Herbal medicine poses challenges in terms of regulation and safety surveillance. The US Food and Drug Administration (FDA) does not regulate herbal supplements in the same manner as conventional drugs, which has implications for their safety and quality control (Hassen et al., 2022). This lack of regulation has led to instances where the majority of herbal medicine users have not consulted healthcare professionals about their use (Mekuria et al., 2017). The Dietary Supplement Health and Education Act (DSHEA) has limited the FDA's ability to effectively regulate herbal supplements as medicines (Marcus, 2015). As a result, herbal medicines are often considered health foods and are not subject to the same regulatory standards as pharmaceutical drugs. This regulatory landscape presents challenges for ensuring the safety and efficacy of herbal medicines, particularly in the absence of premarketing purity and potency regulations (Hassen et al., 2022).

A study by (Hassan et al.2021). provides a comprehensive list of herbs consumed in the US. Fact sheets by NCCIH's Herbs at a Glance webpage, recently also launched as HerbList (App), published about the safety and effectiveness of 50+ popular herbal products marketed for health purposes to help consumers, patients, healthcare providers, and other users in quick access to research-based information (Table 1). Recently (in 2021), a natural product market research firm (SPINS) based in Chicago, Illinois, a natural products industry publication named Nutrition Business Journal (NBJ) based in Boulder, Colorado, and the ABC based in Austin, Texas jointly provided data on the US retail sales of herbal supplements. SPINS specifically reported on the 40 top-selling herbal supplements available in the US market, published by Herbal Gram, a quarterly journal of ABC (Table 1) Most of the herbs are promoted for claimed health benefits such as immune, cardiovascular, respiratory, digestive, prostate, and mental health (Table 2) .

TABLE 1: Summary of herb lists retrieved from ABC and NIH

ABC: American Botanical Council, NIH: National Institute of Health

Source	List of Herbs
ABC	Elderberry, Horehound, Cranberry, Turmeric, Apple cider vinegar, Ginger, Echinacea, Garlic, Fenugreek, Wheatgrass / Barley grass, Saw palmetto, Ashwagandha, Green tea, Ivy leaf, Ginkgo, Cannabidiol (CBD), Black cohosh, Black cohosh, Red yeast rice, Aloe, St John's wort, Flax seed / Flax oil, Milk thistle, Yohimbe, Goji berry, Valerian, Horny goat weed, Bioflavonoid complex, Beetroot, Cinnamon, Sennaf, Green coffee extract, Plant sterols, Ginseng, Chamomile, Garcinia, Fennel, Maca, Açaí, Rhodiola
NIH	Acai, Aloe Vera, Asian Ginseng, Astragalus, Bilberry, Bitter Orange, Black Cohosh, Bromelain, Butterbur, Cat's Claw, Chamomile, Chasteberry, Cinnamon, Cranberry, Dandelion, Echinacea, Elderberry, Ephedra, European Mistletoe, Evening Primrose Oil, Fenugreek, Feverfew, Flaxseed and Flaxseed Oil, Garcinia Cambogia, Garlic, Ginger, Ginkgo, Goldenseal, Grape Seed Extract, Green Tea, Hawthorn, Hoodia, Horse Chestnut, Kava, Lavender, Licorice Root, Milk Thistle, Mugwort, Noni, Passionflower, Peppermint Oil, Pomegranate, Red Clover, Rhodiola, Sage, Saw Palmetto, Soy, St. John's Wort, Tea Tree Oil, Thunder God Vine, Turmeric, Valerian, Yohimbe

TABLE 2: Profile of the 10 top herbs sold by the US mainstream multi-outlet retail channels

S.N.	Herb Name	Common Name	Latin Name	Claimed Health Benefits	Side Effect / Safety
1	Elderberry	European elder, black elder, elderberry, elderflower, Sambucus	Sambucus nigra	Colds, flu, COVID-19	Nausea, vomiting, diarrhea
2	Horehound	White horehound	Marrubium vulgare, Lamiaceae	Respiratory conditions, sore throat	Nausea, oral dryness, sialorrhea, dizziness, anorexia
3	Cranberry	Cranberry, American cranberry, bearberry	Vaccinium macrocarpon , Oxycoccus macrocarpos, Vaccinium	Bladder, stomach, liver disorders, diabetes, wounds, urinary tract infections	Stomach upset, diarrhea
4	Turmeric	Turmeric, turmeric root, Indian saffron	Curcuma longa, Curcuma domestica, Curcuma aromatica	Arthritis, digestive disorders, respiratory infections, allergies, liver disease, depression	Unsafe for pregnancy
5	Apple cider vinegar	ACV, cider vinegar, apple	Malus spp., Rosaceae	Weight loss, blood sugar and blood	Hypokalaemia, hyperreninemia,

		vinegar		pressure regulation, digestive health, cholesterol reduction, immune support, skincare, “cleanse and detox”	osteoporosis, esophageal injury, skin irritation, chemical burns, enamel damage
6	Ginger	Ginger	Zingiber officinale	Nausea & vomiting associated with pregnancy	Abdominal discomfort, heartburn, diarrhea, mouth & throat irritation
7	Echinacea	Echinacea, purple coneflower, coneflower, American coneflower	Echinacea purpurea, Echinacea angustifolia, Echinacea pallida	Common cold, topical use for wounds & skin problems	Nausea, stomach pain, allergic reactions, skin rashes
8	Garlic	Garlic	Allium sativum	Cardiovascular health (cholesterol & blood pressure control)	Breath & body odor, heartburn, upset stomach, allergy, risk of bleeding, drug interaction
9	Fenugreek	Fenugreek	Trigonella foenum-graecum	Diabetes, menstrual cramps, stimulate milk production during breastfeeding	Diarrhea, nausea, dizziness, headaches, hypoglycemia, allergic reactions, hepatotoxicity, birth defects
10	Wheatgrass	Wheatgrass juice	Triticum aestivum	Ulcerative colitis	Nausea, constipation

2.4. Botanical uses in modern drug development

Botanicals have indeed played a significant role in modern drug development, contributing to the discovery of various therapeutic agents. For instance, propolis (Fig 1), a resinous substance collected by honeybees, has been found to contain a diverse range of compounds, including phenols and terpenes, which exhibit potential pharmaceutical properties (Tran et al., 2020). plant metabolites have demonstrated antimalarial activity, with various plant-derived compounds showing promise in combating Plasmodium falciparum, the causative agent of malaria (Pan et al., 2018). Botanicals such as andrographis and oligomeric proanthocyanidins (Fig 2) have been investigated for their enhanced anticancer activity, involving the activation of metabolic and ferroptosis pathways in colorectal cancer (Shimura et al., 2021).

The therapeutic potential of botanicals extends to addressing mental health disorders, with certain plant-derived compounds showing promise in modulating depression and anxiety. For example, specific botanicals have been found to target monoamine neurotransmitters, the hypothalamic–pituitary–adrenal axis, inflammation, oxidative stress, and synaptic plasticity, which are implicated in the pathophysiology of depression (Zhang et al., 2019). Moreover, the anti-inflammatory properties of maslinic acid have been demonstrated, indicating its potential in ameliorating inflammation through the downregulation of NF-κB and STAT-1 (Lee et al., 2020).

In the pharmaceutical industry, the integration of botanicals presents both opportunities and challenges. While botanicals offer a vast source of bioactive compounds with diverse therapeutic applications, their complex chemical compositions and variability pose challenges in standardization and quality control. the bioavailability and delivery of natural agents, such as through mesoporous silica nanospheres, are areas of active research to enhance the efficacy of botanical-based therapies, particularly in anticancer strategies (AbouAitah & Łojkowski, 2021).

Botanicals have made notable contributions to modern drug development, with their diverse applications in antimalarials, anticancer agents, antioxidants, analgesics, cardiac medications, and cognitive support. Ongoing research continues to explore the therapeutic potential of plant-derived compounds, addressing challenges related to standardization, quality control, and delivery. The pharmaceutical industry recognizes the significance of botanicals and continues to harness their therapeutic potential in the development of novel medications.

2.5. Advantages and disadvantages of herbal medicine

2.5.1. Advantage of herbal medicine

Herbal medicine offers several advantages that make it a valuable treatment option. Firstly, herbal medicines are known for their holistic approach, addressing not only the physical symptoms but also the emotional, mental, and spiritual aspects of health (Peprah et al., 2019). This holistic approach aligns with the traditional view of health as a complete state of well-being, encompassing various aspects of an individual (Peprah et al., 2019). One of the most significant advantages of herbal medicine is the relatively fewer side effects compared to conventional pharmaceuticals. Studies have shown that herbal medicines can alleviate disease symptoms, improve the quality of life, and prolong the survival of patients with cancer, all while minimizing adverse effects (Lee et al., 2021).

Table 3: Notable Botanicals in Modern Drug Development (Zhang et al., 2019).

Plant Source	Active Compound	Therapeutic Use	Figure
Honeybees	Propolis	Phenols and terpenes with potential pharmaceutical properties	Figure (1)
Andrographis and other plants	Oligomeric proanthocyanidins	Anticancer activity, activating metabolic and ferroptosis pathways in colorectal cancer	Figure (2)
Various plants	Botanical compounds	Targeting monoamine neurotransmitters, the hypothalamic–pituitary–adrenal axis, inflammation, oxidative stress, and synaptic plasticity for depression and anxiety	-
Olive tree	Maslinic acid	Anti-inflammatory properties, downregulating NF-κB and STAT-1	-

Figure 1: Propolis from Honeybees

Figure 2: Oligomeric Proanthocyanidins from Andrographis and Other Plants

Moreover, herbal medicines are often more affordable and accessible than their pharmaceutical counterparts, particularly in developing countries where they are the staple of medical treatment for a wide range of ailments (Fokunang et al., 2020). The cultural significance of herbal medicine also plays a crucial role, as it has been a part of traditional medical practices for centuries, offering a sense of familiarity and trust to those who use it (Zhou & Zhou, 2015).

Herbal medicines have been recognized for their wide range of applications, including the treatment of chronic diseases such as diabetes and kidney disease (Xu et al., 2022). The potential value associated with the application of herbal medicine in treating chronic diseases has garnered attention due to its unique advantages in managing these conditions (Xu et al., 2022). the multicomponent nature of herbal medicines allows them to target multiple organs and cellular sites, providing a complete holistic approach to treatment (Iizuka & Hamamoto, 2015; Chen et al., 2022). This network-oriented approach is preferable for identifying bioactive components and understanding the integrated effects of herbal medicines (Chen et al., 2022).

2.5.2. Disadvantages of herbal medicine

Herbal medicine, while often lauded for its potential health benefits, presents several disadvantages that warrant careful consideration. One significant concern is the potential for interactions with conventional drugs, as highlighted by (Alyami et al., 2020). This interaction risk can lead to adverse effects and compromised therapeutic outcomes. The variability in the potency and quality of herbal products, as well as the prevalence of misidentification and adulteration, pose substantial challenges. Yang et al. (2018) and Parvez & Rishi (2019) underscore the intrinsic toxicity of herbs, incorrect processing, contamination, and interactions with medications as contributors to these issues. the limited scientific evidence and data on herbal pharmacokinetics hinder the comprehensive evaluation and reporting of adverse reactions and underlying mechanisms, as noted by Parvez and Rishi Parvez & Rishi (2019) and (Yang et al., 2022). Moreover, the use of herbal medications during pregnancy is cautioned against due to the lack of scientific validation and the potential for adverse effects on fetal health, as elucidated by (Elba et al., 2022).

these factors underscore the importance of approaching the use of herbal medicine with caution and highlight the need for further research, stringent quality control measures, and enhanced regulation to mitigate these disadvantages.

2.6. Plant parts used for herbal medicine

The use of plant parts for herbal medicine has been a longstanding practice, with various parts of plants being utilized for their medicinal properties. According to the World Health Organization (WHO), herbal medicine comprises active end products that contain underground or aerial parts of either plants or plant materials or a combination of both (Jahromi et al., 2021). Leaves and fresh plant materials were found to be more frequently used for medicine preparation than other parts in an ethnobotanical study in Ethiopia (Chekole et al., 2015). Similarly, a review on medicinal plants used in the management of respiratory problems in Ethiopia found that leaves were the most important plant parts used to prepare medicines, followed by roots (Haile et al., 2022), a study on the diversity and utilization of medicinal flora in India revealed that leaves contributed to medicinal use in about 63% of the species, followed by fruits, underground parts, and flowers (Humaira et al., 2020).

The use of different plant parts for specific medicinal purposes has also been documented. For instance, the whole plant parts of Aristea ecklonii are used as herbal medicine for venereal diseases in Eswatini and South Africa (Maroyi, 2020). In addition, a study on the treatment of infertility in males and females in the West Bank/Palestine identified specific plant parts, such as pollen grains from Ceratonia siliqua and roots of Ferula hermonis, which were highly cited for their efficacy in treating infertility (Jaradat & Zaid, 2019). Moreover, a review on medicinal plants with anti-inflammatory activities highlighted the use of medicinal plants in preventive, promotional, and curative applications, emphasizing the diverse applications of plant parts in herbal medicine (Jyoti, S. 2023).

The preparation methods for herbal remedies also vary, with freshly harvested plant parts being predominantly used for remedy preparation compared to dried forms in certain regions (Assen et al., 2021). The most widely used methods of remedy preparation include crushing and powdering, as documented in an ethnobotanical study in Ethiopia (Assen et al., 2021).

It is important to note that the utilization of plant parts for herbal medicine is deeply rooted in traditional knowledge and indigenous practices. For example, an ethnobotanical survey in Nigeria revealed that the majority of herb sellers and traditional medical practitioners claimed no occurrence of side effects following patients' use of herbal preparations, indicating the long-standing use and perceived safety of these traditional remedies (Shehu et al., 2017).

the utilization of plant parts for herbal medicine is a widespread and diverse practice, with different parts of plants being employed for specific medicinal purposes. The traditional knowledge and practices associated with the use of plant parts for herbal remedies underscore the importance of preserving and documenting this valuable information for future generations.

Table 4 Some plant parts used for herbal medicine

Plant Part	Medicinal Uses	Example Plant	Photo
Leaves	Most commonly used; treat various ailments	Aloe vera	
Roots	Often used for chronic conditions	Ginger	
Flowers	May have anti-inflammatory or other properties	Chamomile	
Fruits	Can be rich in antioxidants and vitamins	Elderberry	
Seeds	Sometimes used for digestive or other issues	Fennel	
Bark	Can be used for pain relief or other purposes	Willow	
Whole Plant	Used for specific conditions like venereal diseases	Aristea ecklonii	

2.7. Dosage forms of herbal medicine

Dosage forms of herbal medicine are crucial for ensuring the effective delivery of phytoconstituents to the human body. Phospholipid-based delivery systems have been identified as a promising technique for enhancing the bioavailability of phytoconstituents (Gnananath et al., 2017). Herbal dosage forms can include decoctions, herbal teas, tinctures, glyceritum, oxymel, herbal tablets, capsules, creams, and confections, which are commonly used for administering herbal medicines (Salunkhe et al., 2021). Notably, herbal tea is a widely used dosage form in traditional and modern alternative medicine systems (Brendler et al., 2022). However, it is essential to consider the potential side effects and adverse effects associated with herbal products, particularly those in powdered dosage forms, such as nephrotoxicity and neurotoxicity (Shrestha et al., 2020).

Sustained-release dosage forms for herbal medicines play a critical role in ensuring the synchronized release of all active components in their original proportion, thereby enhancing their efficacy (Zeng et al., 2016). The incorporation of herbal drugs into suitable dosage forms can significantly improve their efficacy (Dongare et al., 2021). Herbal formulation dosage forms, which consist of one or more herbs processed in specified quantities, are utilized to provide specific nutritional and therapeutic benefits for diagnosing diseases (Sondhi et al., 2020). Modified herbal medicines have been developed through alterations in shape, form, dose, dosage form, and medicinal ingredients, further expanding the range of available dosage forms (Sailesh & Archana, 2018).

It is important to note that the utilization of traditional medicine, including herbal medicines, has been associated with a lower prevalence of maternal complications, highlighting the potential benefits of these practices (Mudonhi & Nunu, 2021). However, the integration of herbal medicine into healthcare systems may face challenges such as the lack of government policies, financial constraints, poor advocacy, and inadequate training of conventional health practitioners in herbal medicine (Appiah et al., 2018). Moreover, the standardization and quality control of herbal dosage forms are critical to ensure their safety and efficacy (Mubeen et al., 2023). The development and utilization of various dosage forms for herbal medicines play a crucial role in enhancing their bioavailability, efficacy, and safety. However, it is essential to address the challenges associated with their integration into healthcare systems and ensure the standardization and quality control of herbal dosage forms to maximize their therapeutic potential.

Table 5: Table of Herbal Dosage Forms advantages and disadvantages

Dosage Form	Description	Advantages	Disadvantages
Decoctions	Liquid preparation made by boiling herbs in water	Easy to prepare and consume, good for water-soluble herbs	May destroy heat-sensitive compounds, not suitable for all herbs
Herbal teas	Infusion of herbs in hot water	Gentle extraction, good for volatile compounds	Weak extraction, not suitable for all herbs
Tinctures	Concentrated herbal extract in alcohol	Potent and concentrated, long shelf life	Alcohol content may be a concern for some people
Glyceritum	Concentrated herbal extract in glycerin	Sweet and palatable, good for children	High sugar content may not be suitable for everyone
Oxymel	Mixture of honey and vinegar with herbs	Soothing and antimicrobial, good for sore throats	Not suitable for all conditions, may irritate sensitive skin
Herbal tablets	Solid dosage form made from compressed herbs	Convenient and portable, precise dosage	May not be suitable for children or pregnant women
Capsules	Solid dosage form made from enclosed herbs	Convenient and portable, protects herbs from light and air	May not be suitable for children or pregnant women
Creams	Topical dosage form for external use	Localized delivery, good for skin conditions	May not be suitable for all skin types
Confections	Sweetened dosage form made with herbs	Pleasant taste, good for children and adults	High sugar content may not be suitable for everyone

2.8. Use of medical plant products

Medical plant products have been utilized for various purposes due to their diverse biological activities and potential health benefits. These products have been found to possess medicinal effects, including being used as antihemorrhagic, antiseptic, antileprosy, and wound-healing agents (Kotta et al., 2020). Additionally, plant-derived natural products have played a significant role in the development of new chemotherapeutic agents, such as monoterpenes and fatty acid synthase inhibitors, which have demonstrated potential in anti-cancer drugs and antibiotics (Murata, S. 2016).

Medical cannabis has been appreciated for its medicinal properties, particularly in the management of neuropathic chronic pain, highlighting the safety and potential therapeutic benefits of cannabis-derived products (Bennici et al., 2021). Plant-based diets have been associated with cardiovascular benefits, showing improvements in obesity-related inflammatory profiles and reductions in inflammatory markers (Guedes & Klein, 2021).

The utilization of plants as a natural resource of bioactive compounds for drug formulation to control infectious diseases has been emphasized, indicating the potential of medicinal plants in contributing to the development of therapeutic

interventions (Akram et al., 2021). Additionally, the validation challenges in traditional Egyptian medicine have been addressed, emphasizing the historical use of medicinal plants and the importance of validating their efficacy and safety for medical applications (M. & A., 2022). Medical plant products have been recognized for their diverse biological activities and potential health benefits, ranging from traditional medicinal uses to the development of new therapeutic interventions. The utilization of plant-derived compounds and the conservation of medicinal plants are essential for promoting human health and well-being.

Table 6: Some use of medical plant products

Product/Use	Example Plant	Photo
Antihemorrhagic (stops bleeding)	Witch hazel	
Antiseptic (kills or inhibits microorganisms)	Tea tree oil (Melaleuca alternifolia)	
Antileprosy (treats leprosy)	Chaulmoogra (Hydnocarpus)	
Wound healing	Aloe vera	
Cancer treatment	Periwinkle (Catharanthus roseus)	

Antibiotics	Garlic (Allium sativum)	
Pain management (medical cannabis)	Cannabis sativa	
Cardiovascular health (plant-based diets)	Leafy green vegetables, tomatoes, berries	
Infectious disease control	Neem (Azadirachta indica)	

3. Conclusion

With its extensive history and wide range of uses, herbal medicine is a useful tool for enhancing well-being. Its extensive usage around the world is attributed to its holistic approach, the possibility for fewer side effects, and cultural tolerance. Nonetheless, an integrated strategy is required due to issues with regulation, quality control, and possible drug interactions. The complete medicinal potential of substances derived from plants may yet be unlocked via ongoing study, and their successful integration into contemporary healthcare systems seems likely. Herbal medicine has the potential to substantially contribute to the development of a more comprehensive and long-lasting approach to healthcare for coming generations by integrating traditional knowledge with scientific rigor.

4. References

AbouAitah, K. and Łojkowski, W. (2021). Delivery of natural agents by means of mesoporous silica nanospheres as a promising anticancer strategy. Pharmaceutics, 13(2), 143. https://doi.org/10.3390/pharmaceutics13020143

Abou-Elella, F., Hanafy, E., & Gavamukulya, Y. (2016). Determination of antioxidant and anti-inflammatory activities, as well as in vitro cytotoxic activities of extracts of anastatica hierochuntica (kaff maryam) against hela cell lines. Journal of Medicinal Plants Research, 10(7), 77-87. https://doi.org/10.5897/jmpr2015.6030

Adhikari, P. and Paul, S. (2018). History of indian traditional medicine: a medical inheritance.. Asian Journal of Pharmaceutical and Clinical Research, 11(1), 421. https://doi.org/10.22159/ajpcr.2018.v11i1.21893

Ahmed, H. (2016). Ethnopharmacobotanical study on the medicinal plants used by herbalists in sulaymaniyah province, kurdistan, iraq. Journal of Ethnobiology and Ethnomedicine, 12(1). https://doi.org/10.1186/s13002-016-0081-3

Akram, J., Ahmed, W., & Azmat, R. (2021). Plants as a natural resource of bioactive compounds for drug formulation to control infectious diseases. Journal Advances of Nutrition Science and Technology, 1(1), 11. https://doi.org/10.15228/anst.2021.v01.i01.p02

Akram, M. and Nawaz, A. (2017). Effects of medicinal plants on alzheimer's disease and memory deficits. Neural Regeneration Research, 12(4), 660. https://doi.org/10.4103/1673-5374.205108

Alshakka, M., Badulla, W., Alshagga, S., Awadh, N., Jha, N., & Ibrahim, M. (2021). Monitoring the safety of herbal medicines in yemen: a call for action. Journal of Pharmaceutical Research International, 59-63. https://doi.org/10.9734/jpri/2021/v33i49a33302

Alyami, H., Orabi, M., Aldhabbah, F., Alturki, H., Aburas, W., Alfayez, A., … & Alsuhaibani, N. (2020). Knowledge about covid-19 and beliefs about and use of herbal products during the covid-19 pandemic: a cross-sectional study in saudi arabia. Saudi Pharmaceutical Journal, 28(11), 1326-1332. https://doi.org/10.1016/j.jsps.2020.08.023

Amin, H., Hussain, F., Maggiolini, M., & Vidari, G. (2018). Bioactive constituents from the traditional kurdish plant iris persica. Natural Product Communications, 13(9), 1934578X1801300. https://doi.org/10.1177/1934578x1801300907

Amorha, K., Nwabunike, I., Okwumuo, B., Ayogu, E., Nduka, S., & Okonta, M. (2019). Use of herbal medicines in a nigerian community and their reported adverse

effects: a pilot study. Tropical Journal of Pharmaceutical Research, 17(10), 2067. https://doi.org/10.4314/tjpr.v17i10.25

Ananchaisarp, T., Rungruang, S., Theerakulpisut, S., Kamsakul, P., Nilbupha, N., Chansawangphop, N., … & Prasertsri, K. (2021). Usage of herbal medicines among the elderly in a primary care unit in hat yai, songkhla province, thailand. Asian Biomedicine, 15(1), 35-42. https://doi.org/10.2478/abm-2020-0005

Appiah, B., Amponsah, I., Poudyal, A., & Mensah, M. (2018). Identifying strengths and weaknesses of the integration of biomedical and herbal medicine units in ghana using the who health systems framework: a qualitative study. BMC Complementary and Alternative Medicine, 18(1). https://doi.org/10.1186/s12906-018-2334-2

Aragaw, T., Afework, D., & Getahun, K. (2020). Assessment of knowledge, attitude, and utilization of traditional medicine among the communities of debre tabor town, amhara regional state, north central ethiopia: a cross-sectional study. Evidence-Based Complementary and Alternative Medicine, 2020, 1-10. https://doi.org/10.1155/2020/6565131

Armarkar, A., Mahure, D., Pounikar, A., Bhagat, R., & Nagare, D. (2021). An overview on the biosynthetic pathways and medicinal values of secondary metabolites. Journal of Pharmaceutical Research International, 100-114. https://doi.org/10.9734/jpri/2021/v33i33a31777

Aronson, J. (2016). Defining 'nutraceuticals': neither nutritious nor pharmaceutical. British Journal of Clinical Pharmacology, 83(1), 8-19. https://doi.org/10.1111/bcp.12935

Assen, Y., Woldearegay, M., & Haile, A. (2021). An ethnobotanical study of medicinal plants in kelala district, south wollo zone of amhara region, northeastern ethiopia. Evidence-Based Complementary and Alternative Medicine, 2021, 1-10. https://doi.org/10.1155/2021/6651922

Atanasov, A., Waltenberger, B., Pferschy-Wenzig, E., Linder, T., Wawrosch, C., Uhrín, P., … Stuppner, H. (2015). Discovery and resupply of pharmacologically active plant-derived natural products: a review. *Biotechnology Advances*, 33(8), 1582-1614. [Online] Available at: https://doi.org/10.1016/j.biotechadv.2015.08.001

Bennici, A., Mannucci, C., Calapai, F., Cardia, L., Ammendolia, I., Gangemi, S., … & Soler, D. (2021). Safety of medical cannabis in neuropathic chronic pain management. Molecules, 26(20), 6257. https://doi.org/10.3390/molecules26206257

Bhatt, S. (2020). Role of ayurveda medicine with relevance of liver cancer. International Journal of Medical and Biomedical Studies, 4(3). https://doi.org/10.32553/ijmbs.v4i3.1067

Brendler, T., Brinckmann, J., Daoust, M., He, H., Masé, G., Steffan, K., … & Williams, M. (2022). Suitability of botanical extracts as components of complex mixtures used in herbal tea infusions—challenges and opportunities. Frontiers in Pharmacology, 13. https://doi.org/10.3389/fphar.2022.1013340

Chali, B., Hasho, A., & Berhanu, N. (2021). Preference and practice of traditional medicine and associated factors in jimma town, southwest ethiopia. Evidence-Based Complementary and Alternative Medicine, 2021, 1-7. https://doi.org/10.1155/2021/9962892

Chekole, G., Asfaw, Z., & Kelbessa, E. (2015). Ethnobotanical study of medicinal plants in the environs of tara-gedam and amba remnant forests of libo kemkem district, northwest ethiopia. Journal of Ethnobiology and Ethnomedicine, 11(1). https://doi.org/10.1186/1746-4269-11-4

Chen, J., Chen, Y., Du, X., Tao, H., Pu, Z., Shi, X., … & Duan, J. (2022). Fuzzy identification of bioactive components for different efficacies of a medicinal herb by bp neural network association analysis of uplc-q-tof/mse and integrated effects.. https://doi.org/10.21203/rs.3.rs-1319361/v1

Chien, T., Liu, C., Chang, Y., Fang, C., Pai, J., Wu, Y., … & Chen, S. (2022). Therapeutic effects of herbal-medicine combined therapy for covid-19: a systematic review and meta-analysis of randomized controlled trials. Frontiers in Pharmacology, 13. https://doi.org/10.3389/fphar.2022.950012

Choudhary, P., Chalisgaonkar, C., Marathe, N., & Lakhtakia, S. (2015). Use of traditional eye medicines by patients with corneal ulcer in india. International Journal of Medical Science and Public Health, 4(7), 1001. https://doi.org/10.5455/ijmsph.2015.29032015206

Danan, G. and Teschke, R. (2019). Roussel uclaf causality assessment method for drug-induced liver injury: present and future. Frontiers in Pharmacology, 10. https://doi.org/10.3389/fphar.2019.00853

Dongare, P., Motule, A., Dubey, M., More, M., Patinge, P., Bakal, R., … & Manwar, J. (2021). Recent development in novel drug delivery systems for delivery of herbal drugs: an updates. GSC Advanced Research and Reviews, 8(2), 008-018. https://doi.org/10.30574/gscarr.2021.8.2.0158

Elba, F., Hilmanto, D., & Poddar, S. (2022). Factors influencing the use of herbal medications during pregnancy at public health center, indonesia. Journal of Public Health Research, 11(4), 227990362211399. https://doi.org/10.1177/22799036221139939

Fokunang, E., Fonmboh, D., Mballa, R., Nyuyki, A., Fokunang, L., Kaba, N., … & Fokunang, C. (2020). Pharmacovigilance of natural herbal medicines research for efficacy, safety and quality assurance of phytomedicine products. Journal of

Complementary and Alternative Medical Research, 21-37. https://doi.org/10.9734/jocamr/2020/v12i130198

Funk, J., & Schneider, C. (2021). Perspective on improving the relevance, rigor, and reproducibility of botanical clinical trials: lessons learned from turmeric trials. *Frontiers in Nutrition*, 8. [Online] Available at: https://doi.org/10.3389/fnut.2021.782912

Gerontakos, S., Casteleijn, D., & Wardle, J. (2021). Clinician perspectives and understanding of the adaptogenic concept: a focus group study with naturopaths and western herbalists. Integrative Medicine Research, 10(1), 100433. https://doi.org/10.1016/j.imr.2020.100433

Ginwala, R., Bhavsar, R., Chigbu, D., Jain, P., & Khan, Z. (2019). Potential role of flavonoids in treating chronic inflammatory diseases with a special focus on the anti-inflammatory activity of apigenin. Antioxidants, 8(2), 35. https://doi.org/10.3390/antiox8020035

Gnananath, K., Nataraj, K., & Rao, B. (2017). Phospholipid complex technique for superior bioavailability of phytoconstituents. Advanced Pharmaceutical Bulletin, 7(1), 35-42. https://doi.org/10.15171/apb.2017.005

Guedes, M. and Klein, M. (2021). Cardiovascular benefits of plant-based diets. International Journal of Cardiovascular Sciences, 35(1), 11-13. https://doi.org/10.36660/ijcs.20210262

Haile, A., Tsegay, B., Seid, A., Adnew, W., & Moges, A. (2022). A review on medicinal plants used in the management of respiratory problems in ethiopia over a twenty-year period (2000–2021). Evidence-Based Complementary and Alternative Medicine, 2022, 1-14. https://doi.org/10.1155/2022/2935015

Hassen, G., Belete, G., Carrera, K., Iriowen, R., Araya, H., Alemu, T., … & Jain, N. (2022). Clinical implications of herbal supplements in conventional medical practice: a us perspective. Cureus. https://doi.org/10.7759/cureus.26893

Holoff, R. (2021). Traditional medicine in social work practice.. https://doi.org/10.32920/ryerson.14657157

Horchani, A., Chaabane, F., Barboura, M., Mokdad-Bzeouich, I., Abbassi, A., Trabelsi, A., … Chekir-Ghedira, L. (2021). Phytochemistry and biological evaluation of *Daphne gnidium* L. butanol extract. *Pharmacognosy Journal*, 13(6s), 1688-1693. [Online] Available at: https://doi.org/10.5530/pj.2021.13.217

Hoshino, T., Muto, N., Tsukada, S., Nakamura, T., & Maegawa, H. (2018). European ethnopharmaceuticals for self-medication in japan: review experience of vitis vinifera l., folium extract and vitex agnus-castus l., fructus extract as otc drugs. Medicines, 5(1), 3. https://doi.org/10.3390/medicines5010003

Huan, J., Ma, X., Li, S., Hu, D., Chen, H., Wang, Y., … Wang, Y. (2023). Effect of botanical drugs in improving symptoms of hypertensive nephropathy: analysis of real-world data, retrospective cohort, network, and experimental assessment. *Frontiers in Pharmacology*, 14. [Online] Available at: https://doi.org/10.3389/fphar.2023.1126972

Iitsuka, H., Koizumi, K., Inujima, A., Suzaki, M., Mizuno, Y., Takeshita, Y., … & Shibahara, N. (2018). Discovery of a sugar-based nanoparticle universally existing in boiling herbal water extracts and their immunostimulant effect. Biochemistry and Biophysics Reports, 16, 62-68. https://doi.org/10.1016/j.bbrep.2018.08.004

Iizuka, N. and Hamamoto, Y. (2015). Constipation and herbal medicine. Frontiers in Pharmacology, 6. https://doi.org/10.3389/fphar.2015.00073

Jahromi, B., Pirvulescu, I., Candido, K., & Knezevic, N. (2021). Herbal medicine for pain management: efficacy and drug interactions. Pharmaceutics, 13(2), 251. https://doi.org/10.3390/pharmaceutics13020251

Jain, A., Madu, C., & Lu, Y. (2021). Phytochemicals in chemoprevention: a cost-effective complementary approach. *Journal of Cancer*, 12(12), 3686-3700. [Online] Available at: https://doi.org/10.7150/jca.57776

Jaradat, N. and Zaid, A. (2019). Herbal remedies used for the treatment of infertility in males and females by traditional healers in the rural areas of the west bank/palestine. BMC Complementary and Alternative Medicine, 19(1). https://doi.org/10.1186/s12906-019-2617-2

Jyoti, S. (2023). A review on medicinal plants with anti-inflammatory activities. International Journal of Pharmaceutical Sciences and Medicine, 8(4), 66-77. https://doi.org/10.47760/ijpsm.2023.v08i04.006

Khalek, M., Khatun, Z., Habib, M., & Karim, M. (2015). Antitumor activity of manilkara zapota (l.) fruits against ehrlich ascites carcinoma in mice. Biologija, 61(3-4). https://doi.org/10.6001/biologija.v61i3-4.3206

Kotta, J., Lestari, A., Candrasari, D., & Hariono, M. (2020). Medicinal effect, in silico bioactivity prediction, and pharmaceutical formulation of ageratum conyzoides l.: a review. Scientifica, 2020, 1-12. https://doi.org/10.1155/2020/6420909

Lee, J., Gong, Y., Xie, D., Jeong, H., Seo, H., Kim, J., … & Kwon, T. (2021). Anticancer effect of erm210 on liver cancer cells through ros/mitochondria-dependent apoptosis signaling pathways. In Vivo, 35(5), 2599-2608. https://doi.org/10.21873/invivo.12542

Lee, W., Kim, J., Park, E., & Bae, J. (2020). Maslinic acid ameliorates inflammation via the downregulation of nf-κb and stat-1. Antioxidants, 9(2), 106. https://doi.org/10.3390/antiox9020106

Li, Y., Li, J., Zhong, D., Zhang, Y., Zhang, Y., Guo, Y., … & Jin, R. (2020). Clinical practice guidelines and experts' consensuses of traditional chinese herbal medicine for novel coronavirus (covid-19): protocol of a systematic review. Systematic Reviews, 9(1). https://doi.org/10.1186/s13643-020-01432-4

Li, Z., Li, C., Zhang, X., Yang, H., Cui, X., & Huang, L. (2020). Policies and problems of modernizing ethnomedicine in China: a focus on the Yi and Dai traditional medicines of Yunnan Province. *Evidence-Based Complementary and Alternative Medicine*, 2020, 1-14. [Online] Available at: https://doi.org/10.1155/2020/1023297

Liu, M., Yan, J., Wu, Y., Zhu, H., Huang, Y., & Ke-ming, W. (2022). The impact of herbal medicine in regulating intestinal flora on female reproductive disorders. Frontiers in Pharmacology, 13. https://doi.org/10.3389/fphar.2022.1026141

Lowe, H., Steele, B., Bryant, J., Fouad, E., Toyang, N., & Ngwa, W. (2021). Antiviral activity of Jamaican medicinal plants and isolated bioactive compounds. *Molecules*, 26(3), 607. [Online] Available at: https://doi.org/10.3390/molecules26030607

M., A. and A., M. (2022). Medicinal plants and their validation challenges in traditional egyptian medicine. Journal of Applied Pharmaceutical Science. https://doi.org/10.7324/japs.2022.120303

Marcus, D. (2015). Dietary supplements: what's in a name? what's in the bottle?. Drug Testing and Analysis, 8(3-4), 410-412. https://doi.org/10.1002/dta.1855

Maroyi, A. (2020). Review of medicinal applications, phytochemistry and pharmacological properties of aristea ecklonii. Journal of Pharmacy and Nutrition Sciences, 10(2), 46-50. https://doi.org/10.29169/1927-5951.2020.10.02.1

Mekuria, A., Erku, D., Gebresillassie, B., Birru, E., Tizazu, B., & Ahmedin, A. (2017). Prevalence and associated factors of herbal medicine use among pregnant women on antenatal care follow-up at university of gondar referral and teaching hospital, ethiopia: a cross-sectional study. BMC Complementary and Alternative Medicine, 17(1). https://doi.org/10.1186/s12906-017-1608-4

Mn, S., Matapathi, S., & Dixit, A. (2018). Conservation and preservation of medicinal plants-leads from ayurveda and vrikshayurveda. International Journal of Complementary & Alternative Medicine, 11(5). https://doi.org/10.15406/ijcam.2018.11.00412

Mubeen, A., Atchaya, A., Ilakiya, S., U, R., Rojamani, K., & Vijayalakshmi, S. (2023). Comparative standardization studies of marketed polyherbal tablets. International Journal of Multidisciplinary Research and Growth Evaluation, 4(2), 346-350. https://doi.org/10.54660/.ijmrge.2023.4.2.346-350

Mudonhi, N. and Nunu, W. (2021). Traditional medicine utilisation and maternal complications during antenatal care among women in bulilima, plumtree, zimbabwe. Maternal Health Neonatology and Perinatology, 7(1). https://doi.org/10.1186/s40748-021-00130-w

Murata, S. (2016). New chemotherapeutic agents: monoterpenes and fatty acid synthase inhibitors.. https://doi.org/10.5772/62283

Musa, A., Zakari, D., Olaitan, C., Adejo, P., Akoh, Q., & David, P. (2023). Bacteriological analysis and efficacy assessment of liquid herbal mixtures sold in anyigba, kogi state, nigeria. Adesh University Journal of Medical Sciences & Research, 4, 67-71. https://doi.org/10.25259/aujmsr_30_2022

Neuhouser, M., Smith, A., George, S., Gibson, J., Baumgartner, K., Baumgartner, R., … & Ballard, R. (2016). Use of complementary and alternative medicine and breast cancer survival in the health, eating, activity, and lifestyle study. Breast Cancer Research and Treatment, 160(3), 539-546. https://doi.org/10.1007/s10549-016-4010-x

Nuryana, C., Haryana, S., Wirohadidjojo, Y., & Arfian, N. (2020). Achatina fulica mucous improves cell viability and increases collagen deposition in uvb-irradiated human fibroblast culture. Journal of Stem Cells and Regenerative Medicine, 16(1), 26-31. https://doi.org/10.46582/jsrm.1601005

Pan, W., Xu, X., Shi, N., Tsang, S., & Zhang, H. (2018). Antimalarial activity of plant metabolites. International Journal of Molecular Sciences, 19(5), 1382. https://doi.org/10.3390/ijms19051382

Pant, S., Dar, A., Akhter, A., Wani, M., & Shah, N. (2020). Diversity and utilization of medicinal flora of baba ghulam shah badshah university campus rajouri jammu and kashmir, india. Indian Journal of Agricultural Research, (OF). https://doi.org/10.18805/ijare.a-5305

Parvez, M. and Rishi, V. (2019). Herb-drug interactions and hepatotoxicity. Current Drug Metabolism, 20(4), 275-282. https://doi.org/10.2174/1389200220666190325141422

Patwardhan, B., Warude, D., Pushpangadan, P., & Bhatt, N. (2005). Ayurveda and traditional Chinese medicine: a comparative overview. *Evidence-Based Complementary and Alternative Medicine*, 2(4), 465-473. [Online] Available at: https://doi.org/10.1093/ecam/neh140

Peprah, P., Agyemang-Duah, W., Arthur-Holmes, F., Budu, H., Abalo, E., Okwei, R., … & Nyonyo, J. (2019). 'we are nothing without herbs': a story of herbal remedies use during pregnancy in rural ghana. BMC Complementary and Alternative Medicine, 19(1). https://doi.org/10.1186/s12906-019-2476-x

Sailesh, K. and Archana, R. (2018). Therapeutic effects of chitosan nanoparticles. International Research in Medical and Health Science. https://doi.org/10.36437/irmhs.2018.1.1.a

Salunkhe, V., Patil, P., Wadkar, G., & Bhinge, S. (2021). Herbal liposomes: natural network for targeted drug delivery system. Journal of Pharmaceutical Research International, 31-41. https://doi.org/10.9734/jpri/2021/v33i29b31586

Sathiya, R., Manoharan, A., & Rajarajeshwari, A. (2019). The significance of traditional medicinal plants used for treating non-communicable disease by kani tribes in papanasam, tirunelveli district. Journal of Complementary and Alternative Medical Research, 1-7. https://doi.org/10.9734/jocamr/2019/v8i230117

Schiopu, T., Brumarel, M., Peschin, A., & Adauji, S. (2022). Participation of pharmacists in managing the use of herbal medicines by the elderly. Social Pharmacy in Health Care, 8(4), 23-30. https://doi.org/10.24959/sphhcj.22.270

Shahriari, M., Zare, F., & Nimrouzi, M. (2018). Ljekovita uloga bitumena u tradicionalnoj perzijskoj medicini. Acta Medico-Historica Adriatica, 16(2), 283-292. https://doi.org/10.31952/amha.16.2.6

Shehu, A., Magaji, M., Ya'u, J., & Ahmed, A. (2017). Ethno-botanical survey of medicinal plants used for the management of depression by hausa tribes of kaduna state, nigeria. Journal of Medicinal Plants Research, 11(36), 562-567. https://doi.org/10.5897/jmpr2017.6462

Shimura, T., Sharma, P., Sharma, G., Banwait, J., & Goel, A. (2021). Enhanced anti-cancer activity of andrographis with oligomeric proanthocyanidins through activation of metabolic and ferroptosis pathways in colorectal cancer. Scientific Reports, 11(1). https://doi.org/10.1038/s41598-021-87283-y

Shrestha, S., Danekhu, K., Sapkota, B., Jha, N., & Kc, B. (2020). Herbal pharmacovigilance in nepal: challenges and recommendations. F1000research, 9, 111. https://doi.org/10.12688/f1000research.22133.1

Sondhi, S., Singh, N., Goyal, K., & Sk, J. (2020). A laconic review on extraction, biological activities of herbal formulations of berberine: a traditional drug. Journal of Drug Delivery and Therapeutics, 10(5), 345-357. https://doi.org/10.22270/jddt.v10i5.4300

Tegegne, A., Mulugeta, A., Genetu, B., Gurmu, A., & Ergena, A. (2022). Perception towards covid-19 related symptoms and traditional medicine used for their management among patients and their attendants in ethiopian comprehensive specialized hospitals: a cross-sectional study. Infection and Drug Resistance, Volume 15, 5023-5034. https://doi.org/10.2147/idr.s380211

Tran, T., Ogbourne, S., Brooks, P., Sánchez-Cruz, N., Medina-Franco, J., & Quinn, R. (2020). Lessons from exploring chemical space and chemical diversity of propolis components. International Journal of Molecular Sciences, 21(14), 4988. https://doi.org/10.3390/ijms21144988

Tsiogkas, S., Grammatikopoulou, M., Gkiouras, K., Zafiriou, E., Papadopoulos, I., Liaskos, C., … & Bogdanos, D. (2021). Effect of crocus sativus (saffron) intake on top of standard treatment, on disease outcomes and comorbidities in patients with rheumatic diseases: synthesis without meta-analysis (swim) and level of adherence to the consort statement for randomized controlled trials delivering herbal medicine interventions. Nutrients, 13(12), 4274. https://doi.org/10.3390/nu13124274

Wassie, S., Aragie, L., Taye, B., & Mekonnen, L. (2015). Knowledge, attitude, and utilization of traditional medicine among the communities of merawi town, northwest ethiopia: a cross-sectional study. Evidence-Based Complementary and Alternative Medicine, 2015, 1-7. https://doi.org/10.1155/2015/138073

Widowati, L., Siswoyo, H., Sampurno, O., & Halim, F. (2020). The pattern of herbal medicine prescribed by medical doctor for 10 health problems in several cities of indonesia (analysis of jamu registry 2016 and 2018 database).. https://doi.org/10.2991/ahsr.k.200215.122

Wink, M. (2015). Modes of action of herbal medicines and plant secondary metabolites. *Medicines*, 2(3), 251-286. [Online] Available at: https://doi.org/10.3390/medicines2030251

Xu, Y., Chen, J., Wang, H., & Lu, Y. (2022). Research and application of herbal medicine in the treatment of chronic kidney disease since the 21st century: a visualized bibliometric analysis. Frontiers in Pharmacology, 13. https://doi.org/10.3389/fphar.2022.971113

Yang, B., Xie, Y., Guo, M., Rosner, M., Yang, H., & Ronco, C. (2018). Nephrotoxicity and chinese herbal medicine. Clinical Journal of the American Society of Nephrology, 13(10), 1605-1611. https://doi.org/10.2215/cjn.11571017

Yang, M., Song, Z., Gan, H., Zheng, M., Liu, Q., Xing, M., … & Fan, H. (2022). Non-clinical safety evaluation of salvianolic acid a: acute, 4-week intravenous toxicities and genotoxicity evaluations. BMC Pharmacology and Toxicology, 23(1). https://doi.org/10.1186/s40360-022-00622-1

Zeng, N., Xue, C., & Liu, Z. (2022). Natural products and nanotechnology against coronavirus disease 2019. Frontiers in Chemistry, 10. https://doi.org/10.3389/fchem.2022.819969

Zeng, Q., Liu, Z., Huang, A., Zhang, J., & Hong-tao, S. (2016). Preparation and characterization of silymarin synchronized-release microporous osmotic pump

tablets. Drug Design Development and Therapy, 519. https://doi.org/10.2147/dddt.s91571

Zhang, Z., Deng, T., Wu, M., Zhu, A., & Zhu, G. (2019). Botanicals as modulators of depression and mechanisms involved. Chinese Medicine, 14(1). https://doi.org/10.1186/s13020-019-0246-9

Zhao, Q., Luan, X., Zheng, M., Tian, X., Zhao, J., Zhang, W., … & Ma, B. (2020). Synergistic mechanisms of constituents in herbal extracts during intestinal absorption: focus on natural occurring nanoparticles. Pharmaceutics, 12(2), 128. https://doi.org/10.3390/pharmaceutics12020128

Zhao, Z., Liu, T., Zhu, S., Pi, J., Guo, P., Qi, D., … & Li, N. (2021). Natural medicine combined with nanobased topical delivery systems: a new strategy to treat psoriasis. Drug Delivery and Translational Research, 12(6), 1326-1338. https://doi.org/10.1007/s13346-021-01031-3

Zhou, Z. and Zhou, S. (2015). Editorial for special issue on herbal medicines and natural products. Medicines, 2(4), 328-330. https://doi.org/10.3390/medicines2040328

Zhu, H., Yu, D., & Xu, D. (2022). New insights into immunomodulatory properties of lactic acid bacteria fermented herbal medicines. Frontiers in Microbiology, 13. https://doi.org/10.3389/fmicb.2022.1073922