مجلة جامعة بني وليد للعلوم الإنسانية والتطبيقية
Bani Waleed University Journal of Humanities and Applied Sciences
تصدر عن– جامعة بني وليد – ليبيا
Website:https://jhas-bwu.com/index.php/bwjhas/index
المجلد العاشر ـ العدد الثاني ـ 2025 ـ الصفحات (19– 26)
ISSN3005-3900

HERBAL REMEDIES: THE SCIENCE AND TRADITION BEHIND MEDICINAL PLANTS

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العلاجات العشبية: العلم والتقاليد وراء النباتات الطبية

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تاريخ الاستلام: 25-02-2025 تاريخ القبول: 25-03-2025 تاريخ النشر: 05-04-2025

Abstract
Medicinal plants are used as a shape of treatment in almost each culture. ensuring the efficacy, safety, and fine of medicinal vegetation and herbal merchandise has emerged as a crucial difficulty in both evolved and developing nations (Davis, C. C., & Choisy 2024). The Bible and the Vedas both deal with the significant use of natural remedies and medicines. human beings have been using medicinal plants for thousands of years to deal with ailments, prevent epidemics, and preserve and taste food. each inside and among human societies, know-how of their therapeutic characteristics has been transmitted over the years. active chemical compounds created for the duration of secondary metabolism are generally chargeable for the organic characteristics of plant species which are used globally for a spread of functions, including the remedy of infectious illnesses. information at the antimicrobial effects of many flowers that were as soon as notion to be empirical have now been scientifically showed due to the increasing range of stories of pathogenic bacteria which might be resistant to antibiotics. products crafted from vegetation have the capacity to govern microbial increase in a number of situations, along with contamination treatment. whether or not used on my own or along with traditional antimicrobials, some of studies have tried to explain the chemical makeup of those natural antimicrobials and the mechanisms underlying their capacity to inhibit microbial boom.

Keywords: Traditional, Medicine, Medicinal Plants, Phytomedicines, Antioxidant Potential

الملخص:
النباتات الطبية تُستخدم كوسيلة علاجية في تقريباً كل ثقافة. أصبح التأكد من فعالية وسلامة وجودة النباتات الطبية والمنتجات العشبية مسألة هامة في كل من الدول المتقدمة والنامية. تتناول كل من الكتاب المقدس والفيدا الاستخدام الكبير للعلاجات الطبيعية والأدوية. لقد استخدم الناس النباتات الطبية لآلاف السنين لعلاج الأمراض، والوقاية من الأوبئة، وحفظ الطعام وتتبيله. سواء داخل المجتمعات البشرية أو بينها، تم نقل المعرفة بخصائصها العلاجية عبر الأجيال. المركبات الكيميائية النشطة التي تُنتج خلال التمثيل الغذائي الثانوي هي المسؤولة بشكل عام عن الخصائص البيولوجية لأنواع النباتات التي تُستخدم عالمياً لأغراض متنوعة، بما في ذلك علاج الأمراض المعدية. المعلومات حول التأثيرات المضادة للميكروبات للعديد من النباتات التي كان يُعتقد في السابق أنها تجريبية قد تم تأكيدها علمياً الآن بسبب تزايد الدراسات حول البكتيريا الممرضة المقاومة للمضادات الحيوية. المنتجات المصنوعة من النباتات لديها القدرة على التحكم في نمو الميكروبات في عدة حالات، بما في ذلك علاج العدوى. سواء تم استخدامها بمفردها أو مع المضادات الحيوية التقليدية، حاولت بعض الدراسات توضيح التركيب الكيميائي لهذه العلاجات الطبيعية المضادة للميكروبات والآليات التي تكمن وراء قدرتها على تثبيط نمو الميكروبات.

الكلمات الدالة: الطب التقليدي، الطب، النباتات الطبية، الأدوية النباتية، الإمكانيات المضادة للأكسدة

Introduction

Many cultures have applied medicinal plants as herbal treatments for a variety of illnesses for thousands of years. The presence of bioactive compounds in vegetation that can undoubtedly interact with human body structure is the primary motive in their healing features (Jamshidi-Kia et al, 2017). those vegetation may be used therapeutically to treat intellectual and continual illnesses as well as to relieve pain. The significance of plant life in human healthcare is highlighted via the fact that many current medicinal drugs have their roots in conventional plant medicine (Karunakaran et al. 2025).

1.1 History and Cultural Significance

Medicinal plants have lengthy played an enormous position in global recuperation customs. historical societies like the Greeks, Egyptians, Chinese, and Indians recorded the use of plant life for his or her medicinal characteristics (Sharma et al, 2021). for instance:

- historical Egypt: renowned for its great use of frankincense and aloe vera.
- Herbs like ginseng and ginkgo biloba were used for heaps of years in conventional Chinese medication (TCM).
- Ayurveda: India's conventional medical system, which makes use of herbs like ashwagandha, turmeric, and tulsi to treat healing.

1.2 Types of Medicinal Plants

Medicinal plants are classified based on their therapeutic uses, which include:

1. Herbal Remedies: Used in the form of teas, tinctures, or powders. Example: Peppermint for digestion, Echinacea for immunity.
2. Aromatherapy: Essential oils extracted from plants like lavender and chamomile are used for relaxation and stress relief.
3. Phototherapy: Involves using whole plant extracts or active ingredients from plants for medicinal purposes. Example: The use of willow bark extract for pain relief, which contains silicon, a precursor to aspirin.

1.3 Common Medicinal Plants

1. Aloe Vera, or Aloe barbadensis miller, is well-known for its calming effects, particularly on burns and skin irritations. Aloin and emodin, two substances found in aloe, have antibacterial and anti-inflammatory properties (Przeor, 2022).
2. Ginger (Zingiber officinale): Often used to treat inflammation, nausea, and digestive issues. Gingerol, the active component, is well known for its anti-inflammatory and antioxidant qualities (Moghaddasi and Kashani, 2012).
3. . Curcumin, a substance found in turmeric (Curcuma longa), has been researched for its anti-inflammatory, antioxidant, and anticancer effects (Labban, 2014).
4. Commonly used to strengthen the immune system and either prevent or treat colds is Echinacea (Echinacea purpurea). Alkamides, which are found in echinacea, are thought to aid in immune stimulation (Przeor, 2022).
5. Aromatherapy uses lavender (Lavandula angustifolia) for its relaxing and anxiety-reducing properties. It is thought that the active components, such as linalool, work with the central nervous system to encourage relaxation (Przeor, 2022).
6. Mentha piperita, or peppermint, is frequently used to treat respiratory, headache, and digestive issues. Peppermint's primary active component, menthol, has antispasmodic and analgesic effects (Przeor, 2022).
7. Ginseng (Panax ginseng): renowned for enhancing vitality, lowering fatigue, and enhancing mental clarity. Ginsenosides, which are present in it, are thought to alter a number of bodily biological processes. Sulfur compounds like allicin, which are found in garlic (Allium sativum), have been demonstrated to possess antibacterial, antiviral, and antifungal qualities.

2. Pharmacological Properties and Uses

According to Misra et al. (2011), the pharmacological effects of the chemicals present in medicinal plants are thought to be responsible for their therapeutic outcomes. The following are the most significant ability applications.

- Antimicrobial: Plants like garlic and tea tree oil are known for their antibacterial and antifungal properties.
- Anti-inflammatory: Turmeric, ginger, and willow bark (salicin) can reduce inflammation and treat conditions like arthritis.
- Antioxidant: Many plants, such as green tea, contain antioxidants that protect cells from oxidative stress, potentially lowering the risk of chronic diseases like cancer and heart disease.
- Pain relief: Plants like willow bark (rich in salicylates) and capsaicin from chili peppers can help relieve pain.
- Digestive support: Peppermint, ginger, and fennel are commonly used to aid digestion and reduce symptoms of nausea and bloating.
- Immunity boost: Echinacea and elderberry are commonly used to strengthen the immune system and treat colds.

2. 1Challenges and Considerations

Despite the potential benefits, there are some challenges in the use of medicinal plants (Jabaseeli & Umanandhini 2024)

1. Standardization: The potency and quality of medicinal plants can vary widely depending on where they are grown, how they are harvested, and how they are processed.
2. Safety and Side Effects: Even though plants are natural, they can still have side effects or interact with medications. For example, St. John's Wort can interact with antidepressants and reduce their effectiveness (Fadeyi et al. 2024)
3. Sustainability: Overharvesting of certain plant species can lead to their depletion in the wild, making it essential to cultivate medicinal plants responsibly.
4. Regulation: In many countries, the use of medicinal plants is not as strictly regulated as pharmaceutical drugs, which can lead to inconsistent quality and safety standards.

According to Sen and Samanta (2015), medicinal plant life are a wealthy supply of therapeutic dealers which have prompted human medicinal drug for hundreds of years. studies on those flora' pharmacological traits is developing as interest in complementary and alternative medicinal drug grows. it is vital to workout caution whilst using it, recognise the possible benefits and disadvantages, and combine it with the proper medical recommendation. those therapeutic flowers are thought to have a mess of ingredients that can be applied inside the introduction of novel medicinal drugs. furthermore, those flora are crucial to the worldwide development of human cultures (Busia 2024).

In line with UNESCO (1996) (WHO, 2013), conventional medicinal drug and medicinal flora serve as the muse for maintaining good health in the general public of developing nations. furthermore, the manner of extracting and growing various medicinal drugs and chemotherapy tablets from those plants, in addition to natural drugs which have traditionally been applied in rural regions, can be linked to the increasing reliance of advanced countries on using medicinal herbs (Payyappallimana). (2010). over the past ten years, conventional scientific practices have drawn interest from all over the global. modern-day estimates imply that a giant phase of the populace in lots of growing countries more often than not depends on herbal remedies and traditional healers to satisfy their primary clinical desires. These nations may have access to modern medicine, but historically and culturally, herbal remedies, or phytomedicines have frequently reminded popular. Medicinal plants are commonly utilized as raw materials to extract active chemicals that are then used to make various medications. Plant-based compounds are found in blood thinners, antibiotics, anti-malarial drugs, and laxatives. Additionally, the active components of morphine, vincristine, and taxol were separated from opium poppies, yew, periwinkle, and foxglove, respectively.

There are numerous industrial applications for medicinal plants. These include galenicals, phytopharmaceuticals, industrially manufactured pharmaceuticals, herbal teas, traditional remedies, and health foods like nutriceuticals (Bharathy & Thanikachalam 2024). Additionally, because they are a ready source of medications like quinine and reserpine, galenicals like tinctures, and intermediates (like diosgenin from Discorea sp.) for the manufacturing of semi-synthetic drugs, medical plants provide a significant source of foreign exchange for the majority of developing nations. Research advancements in the pharmaceutical sector heavily rely on medicinal plants. In this type of study, active medicinal ingredients are isolated and used directly, semi-synthetic pharmaceuticals are developed, or natural items are actively screened to produce synthetic pharmacologically active molecules.

The global market for plant-based chemicals, including flavors, fragrances, medicines, and dyes, alone brings in billions of dollars every year (Lubbe and Verpoorte, 2011). Classic examples of secondary plant substances in biology and medicine include taxol, vincristine, vinblastine, colchicine, the Chinese antimalarial medication artemisinin, and the Indian Ayurvedic drug forkolin. Medicinal plants are growing in both quantity and export. An estimated $800 million is traded annually in medicinal plants worldwide.For instance, more than 1500 plant species from about 800 genera and 200 families have been turned into therapeutic goods in Germany. Similarly, some 500 species are traded commercially in South Africa. Poland, Germany, and Bulgaria are now acknowledged as leading suppliers of plant-based pharmaceuticals. Facilities and knowledge about upstream and downstream bioprocessing, extraction, purification, and marketing of medicinal plants' industrial potential are essential for the growth and commercialization of bioindustries based on medicinal plants in developing nations. Additionally, rural and lower-income urban communities' reliance on traditional medicinal herbs and plants as supplemental aids to standard pharmaceutical market products is strengthened by the lack of updated socioeconomic and public healthcare systems. Without conducting thorough research among numerous indigenous and other people, recent estimates indicate that over 9,000 plants have known therapeutic uses in a variety of civilizations and nations.

Medicinal Plants' Future

Medicinal plants have a promising future because of the world's greater than half 1,000,000 flowers, the majority of that have no longer but been investigated for their ability scientific uses (Jamshidi-Kia et al, 2017). whilst addressing current or deliberate research, these traits might prove crucial.

Table 1: A few World medicinal herbs with strong antioxidant properties

Active element(s)	Part studied	Type of Plant(s)
Alkaloids, Flavonoids	Rhizomes	*Curculigo orchioides*
Terpenoids. Saponins, Tan-nins	Leaves	*Carica papaya*
Flavonoids, Tannins	Stem bark	*Magnifera indica*
Glycosides	Root	*Plumbago zeylanica*
Vitamin A,C,E, Carotenoids	Leaf	*Aloe vera*
Flavonoids	Bark	*Cassia fistula*
Alkaloids Terpenoids, Saponins	Leaves	*Aegle marmelos*
Active component(s)	Leaves and flower	*Dalbergia sisoo*
Saponin, Sesquiterpenoids,	Seeds	*Emblica officinalis*
Tannins	Aerial root	*Ficus bengalensis*
Vitamin C, Tannins	Stem	*Hemidesmus indicus*
Diterpenes, Lactones,	Whole plant	*Andrographis paniculata*
Alkaloids, Glycosides	Fruit	*Momordica charantia*
Reducing sugar, Flavonoids	seeds	*Moringa olifera*
Alkaloids, Saponin	Leaf	*Ocimum sanctum*

2.3 Features of Therapeutic Plants

• Synergic medicine: Utilizing plant components can either benefit or harm individuals, or reverse any potential harmful consequences, because they operate concurrently. Supporting Official Medicine: Ingredients derived from plants have shown promise in the treatment of difficult diseases like cancer.
• Preventive medicine: Studies have indicated that certain plant-based ingredients may help stop the onset of specific illnesses. This implies that after the disease has already appeared, fewer chemical treatments are administered (Ramawat et al, 2009).

3. Medicinal Plants' Importance for Humans

Using medicinal vegetation has significantly aided inside the development of human lifestyle, along with religions and severa rituals. Aspirin is a few of the numerous current pills which can be derived not directly from medicinal plant life. there are various meals flowers with medicinal features, consisting of garlic. Medicinal flora might also yield new medications (Srivastava, 2018). There are idea to be greater than 250,000 extraordinary styles of flowering flowers. advantages of reading medicinal plant life are gaining an know-how of plant toxicity and safeguarding human beings and animals from herbal poisons. Through plant metabolism technology, for instance, biological diversity is preserved during the cultivation and preservation of medicinal plants. Plant metabolites, particularly secondary chemicals, are what give plants their medicinal properties. Plant metabolites can be classified as either primary or secondary. Physiotherapy is the use of plants or plant extracts for medicinal purposes; this is particularly true for plants that are not typically eaten. Photochemistry is the study of the various secondary metabolic compounds that plants produce, including their isolation, purification, identification, and structure (Jabaseeli, N. B., & Umanandhini 2024)

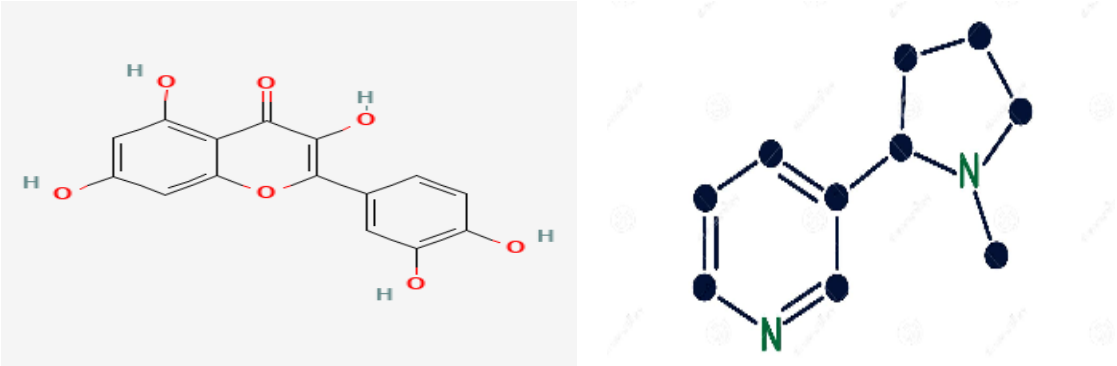
3.2 Primary Metabolites in Plants

Within the nation of vegetation, natural materials produce metabolic tactics which can be essential for plant increase and development (Zaynab, 2019). Add amino acids, carbohydrates, nucleotides, lipids, fatty acids, and steroids.

Figure 1: Monograms of some common herbs medical plants

3.3 Secondary Metabolites in Plants

Organic materials are produced by plants. Do not seem to be involved in plant growth and development (Pagare et al 2015) is produced by various plant families, specific plant family groups, or, more specifically, specific tissues, cells, or stages of plant growth. Add phenols, terpenoids, and special nitrogen metabolites like B. protein amino acids, cyanogenic glycosides, amines, alkaloids, and glucosinolates.



Quercetin (flavonoids) Nicotine (alkaloids)

Figure 1: Chemical structure of Quercetin and Nicotine

Some Active Compounds in Medicinal Plants and Their Mechanisms of Action

1. Alkaloids

- ***Compound*:** Caffeine, Morphine, Codeine.
- ***Mechanism of Action*:** Alkaloids often act on the central nervous system, where they can be either stimulating or sedative depending on the type. For example, caffeine stimulates the central nervous system, while morphine acts as a strong analgesic by interacting with opioid receptors in the brain (Lambo et al. 2024).

2. **Flavonoids**

- ***Compound*:** Quercetin, Rutin.
- ***Mechanism of action*:** Flavonoids have antioxidant properties, helping to reduce the harmful effects of free radicals in the body. They can also act as anti-inflammatory agents and support cardiovascular health by improving blood vessel function and reducing blood pressure (Zayan et al. 2025).

3. **Terpenoids**

- ***Compound*:** Terpenes, Lavender Oil.
- ***Mechanism of action*:** Terpenoids act at the cellular and tissue level, with antibacterial, antifungal, and antiviral properties. They also help to calm the nervous system, reducing anxiety and stress (Hao et al. 2024).

4. **Organic Acids**

- ***Compound*:** Ascorbic Acid (Vitamin C), Folic Acid.
- ***Mechanism of action*:** Ascorbic acid is a powerful antioxidant that helps protect cells from damage caused by free radicals. It also strengthens the immune system and aids in iron absorption.

5. **Tannins**

- ***Compound*:** Green Tea Tannins.
- ***Mechanism of action*:** Tannins have astringent properties that help reduce inflammation and strengthen tissues and blood vessels. They also aid digestion by regulating stomach secretions.

6. **Essential Oils**

- ***Compound*:** Lavender Oil, Peppermint Oil.
- ***Mechanism of action*:** Essential oils contain volatile compounds that can have either calming or stimulating effects. For example, peppermint oil helps soothe headaches and stimulate digestion, while lavender oil is used to alleviate stress and anxiety.

These compounds work by activating or inhibiting specific biological systems in the body, and their mechanisms of action vary depending on their chemical structure and the system they target.

Conclusion

Therefore, it is crucial that open access journals support the efforts of researchers and physicians to identify the primary active ingredients that can be isolated from medicinal plants. The variety and amount of electronic material on medicinal plants as resurgent health aids has increased dramatically due to recent and renewed interest in these plants as well as advances in information technology (Sen & Samanta, 2015) examined a number of online electronic databases and traditional abstraction services as sources of such knowledge. These advances have made it much easier to reach indigenous peoples and civilizations for medicinal plants. Furthermore, the active participation of these organic knowledge keepers and practitioners is ensured.

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