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The role of plants in traditional and modern medicine

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Abstract
Worldwide, diverse tribal communities living in remote areas rely on plants for sustenance, including edible and medicinal parts. Traditional medicine, constituting 40% of healthcare globally, heavily relies on plant-based remedies, comprising 85% of traditional medicines. Indigenous communities have utilized medicinal plants for centuries, treating various common ailments based on longstanding beliefs and observations. These indigenous groups possess extensive knowledge of approximately 6,500 Southeast Asian plants used in traditional healing. The pharmaceutical industry has documented tribal plants and their traditional medicinal uses, exploiting their antimicrobial properties and potential for developing safe anti-cancer and antibiological drugs. With over 50,000 identified medicinal plant species worldwide. While ancient literature recorded the use of medicinal plants, organized research in this field started in 1956 due to declining plant populations and loss of traditional knowledge.
Medicinal plants also called Herbs, have been discovered and used in traditional therapeutic practices since prehistoric times. Herbal plants play an important role in preventing and treating of human diseases. Plants produce thousands of chemical substances like phytochemicals for various functions including defense protection against bacteria, fungi, virus, insects and herbivorous mammals. However, plants are considered as the potential source for the development of new herbal drugs. Medicinal plants are widely used in non-industrialized societies because they are cheaper and lesser side effects than modern medicine. The annual global export value of the thousands of types of plants with medicinal properties was estimated to about US60$ billion per year and it is growing at the rate of 6% per annum. In many countries, there is little regulation of traditional medicine, but the World Health Organization coordinates a network to encourage safe and rational usage. Therefore, the aim of present review is to understand the knowledge of the medicinal plants as a future source of herbal drugs.

Keywords: Drug development, Green synthesis, Tribal plants, Antimicrobial, Herbal Remedies

Introduction
Plants have been used as medicine for thousands of years in various cultures around the world. Throughout history, humans have relied on plants for food and medicine. Early humans learned to identify plants with medicinal properties, and this knowledge grew over time. Today, many drugs used to treat diseases like infections, heart conditions, and cancer are derived from plants or their derivatives. For example, aspirin, one of the world's most widely used pain relievers, comes from the bark of willow trees.
Herbal medicine, also known as botanical medicine or phytotherapy, involves using different parts of plants (leaves, roots, flowers, etc.) for their medicinal properties. There are tribal communities worldwide, living in dispersed groups in various landscapes [1, 2]. Their economic, cultural, and social patterns vary across regions. For example; in India, the tribal population comprises 8.6% of the total population [2, 46]. These indigenous people possess deep knowledge of using plants for medicinal purposes, with Southeast Asian traditional healers utilizing nearly 6500 plant species. Tribal plants and their traditional medicinal uses have dominated the modern pharmaceutical industry's documentation [3, 4]. These plants exhibit inherent antimicrobial properties, which can be further enhanced through Silver Nanoparticles (AgNPs) synthesis. They also hold promise as sources for developing anti-cancer and antibiological drugs with minimal or no adverse effects [4, 5, 6, 50].
Silver, known for its antimicrobial properties, was used by ancient civilizations such as the Greeks, Romans, and Egyptians as a food and water preserver. In traditional Ayurvedic medicine, silver has been used for over 2000 years in the form of silver ash, both suspended and colloidal, to restore the body [6, 7, 45, 47]. Nanotechnology has diverse applications in modern research, including theranostic agents, ocular drug delivery, nano-enabled drug delivery systems, and agriculture.

Nanoparticles are used in food industry, water treatment, textiles, and electronics. Indigenous and tribal people heavily rely on forest resources for their sustenance, including food, medicine, and building materials [8, 9, 48, 56, 57].

However, tribal knowledge is declining due to factors such as development projects, reduced dependency on forests, and the younger generation leaving tribal cultures [36, 51]. The loss of undocumented plant names and terminologies specific to each region is a concern [10, 11, 52]. Tribal communities often resist sharing their knowledge, requiring anthropologists to establish friendly relationships to obtain data [36, 53]. For instance, *Rauwolfia serpentina* is used by tribes as an antidote to snakebite, while its reserpine is utilized to treat hypertension. *Artemisia annua*, known for treating fevers, led to the discovery of artemisinin, an antimalarial drug [35, 44]. The choice of plant materials for research should consider their freshness and unique properties [38, 49]. Various forest plants have specific characteristics, such as *Catharanthus roseus* with vincristine, *Annona squamosa* with toxic compounds, and *Cleistanthus collinus* with *Cleistanthin-B* harmful to fish. The tribal population also cultivates millets with distinct nutritional and toxicological aspects. Gathering and digitizing tribal knowledge and conducting laboratory research with the expertise of scientists is essential [11, 12, 13, 14, 39].

Using various methodologies to discover new plant-derived medicinal drugs: herbal remedies

The discovery of new plant-derived medicinal drugs is a multifaceted process that often involves various methodologies. One common approach is the ethnobotanical method, which involves studying the traditional medicinal uses of plants by indigenous cultures [58]. Ethnobotanical studies can provide valuable insights into the potential therapeutic properties of plants and guide the selection of plants for further investigation. Another approach is the phytochemical method, which involves isolating and identifying the bioactive compounds present in plants. This method often involves the use of techniques such as chromatography and spectroscopy to separate and analyze the chemical constituents of plants [59]. Once bioactive compounds have been identified, they can be further studied using *in vitro* and *in vivo* assays to determine their pharmacological properties and potential therapeutic applications. Additionally, computational methods such as molecular modeling and virtual screening can be used to predict the potential bioactivity of plant-derived compounds and guide the selection of compounds for further study [60].

In this research, herbs were found to be the most commonly used plants (46%), followed by shrubs (26%), trees (14%), and climbers (14%). Families such as *Euphorbiaceae*, *Fabaceae*, *Solanaceae*, and *Asteraceae* were frequently utilized, with the first two families enabling ten treatments [32, 40]. Various parts of the plants, including leaves, roots, stems, fruits, barks (root and stem), and flowers, were used for medicinal purposes, with leaves being the most commonly used component. Skin conditions were prevalent in the study area [13, 14, 15]. The Kani and Uttar karanaraka Indian tribes used 31 plants to treat skin issues, and herbal preparations [31, 41]. Traditional healers treated stomach issues with nine plant species, while the Paliyar community used 21 medicinal plants for gastrointestinal complaints [33, 42]. Jaundice was treated with 13 plants, toothache with *Spilanthes acmella*, and diabetes with *Syzygium cumini*, *Santalum album*, and *Ficus retusa* [37, 43].

Respiratory issues were addressed with ten different remedies, including *Ocimum basilicum* and *Adhatoda vasica* [34, 55]. Other studies from different regions of the world have also listed plants used for treating skin diseases, wounds, gastrointestinal problems, and respiratory illnesses [16, 17]. Topical and internal applications of various plant pastes, juices, and powders were reported for treating paralysis, poison bites, asthma, leucorrhoea, headache, snakebite, arthritis, and other ailments [18, 19, 20, 21].

The majority of treatments involved oral administration, with preparations based on single plants or combinations of plant parts [54]. Fresh plant parts were preferred, but dried parts were used when fresh ones were not available [22, 23, 24, 25]. The tribal community's strong belief in the efficacy of herbal medicine was evident, emphasizing their heavy reliance on medicinal plants for healthcare [24, 25, 26]. Continuing research on the pharmacological validation, chemical studies, and ethnobotanical exploration will contribute to the development of cost-effective and reliable herbal medicine for the benefit of humanity [27, 28, 29, 30].

In 1803, morphine was isolated from Papaver somniferum, marking the start of drug discovery. Around 80,000 plants have been used for medicine, with 20% in India [61]. In a rat study, naringenin from citrus fruits showed antioxidant, liver-protective, and anti-inflammatory effects when given before doxorubicin, an anticancer drug. Doxorubicin increases harmful reactive species, causing damage and inflammation. Naringenin reduced lipid peroxidation, increased antioxidant enzymes, and lowered inflammatory mediators. Liver tissue tests confirmed naringenin's protective effect against doxorubicin-induced liver damage [62]. A great example of this drug discovery process is artemisinin derivatives from Artemisia annua, also known as (Qing-hao) in Chinese. This plant produces a highly oxygenated sesquiterpene called artemisinin, which is very effective against malaria. However, it's not easily absorbed when taken orally. Another example is Thornapple Datura stramonium, which contains the alkaloid atropine and has been used for asthma, but it's also a potent hallucinogen. Bicyclol, a synthetic second-generation derivative of a compound from the fruit of the Chinese magnolia vine, is another example. It's used to treat hepatitis, a deadly condition caused by the hepatitis B virus. Overall, discovering new plant-derived medicinal drugs is a complex process that involves various methods to identify and develop treatments for different diseases.

Table 1: Showcasing useful plants used as medicine

Botanical Name	Local Name	Parts Used	Preparation Method	Ethno-medical Uses
Aloe vera	Ghritkumari	Gel from leaves	Topical application	Sunburn relief, wound healing, skin irritation
Camellia sinensis	Green tea	Leaves	Infusion	Boosting metabolism, antioxidant properties
Curcuma longa	Turmeric	Rhizomes	Powder	Anti-inflammatory, digestive aid, wound healing
Allium sativum	Garlic	Bulbs	Crushed, raw	Immune system support, cardiovascular health
Matricaria chamomilla	Chamomile	Flowers	Herbal infusion	Relaxation, digestive aid, sleep improvement
Panax ginseng	Ginseng	Roots	Decoction	Energy boost, cognitive function, immune support

Mentha piperita	Peppermint	Leaves	Essential oil	Digestive aid, headache relief, respiratory support
Lavandula angustifolia	Lavender	Flowers	Essential oil	Relaxation, sleep aid, anxiety relief
Zingiber officinale	Ginger	Rhizomes	Tea, infusion	Digestive aid, anti-nausea, anti-inflammatory
Salvia officinalis	Sage	Leaves	Infusion	Sore throat relief, antimicrobial properties
Echinacea purpurea	Purple coneflower	Aerial parts	Tincture	Immune system support, cold and flu relief
Melissa officinalis	Lemon balm	Leaves	Herbal infusion	Stress reduction, sleep aid, digestive support
Calendula officinalis	Calendula	Flowers	Oil infusion	Skin healing, anti-inflammatory, wound treatment
Hypericum perforatum	St. John's wort	Aerial parts	Infused oil	Mood support, nerve pain relief, wound healing
Curcuma zedoaria	Zedoary	Rhizomes	Powder	Digestive aid, anti-inflammatory, detoxification
Rosmarinus officinalis	Rosemary	Leaves	Herbal infusion	Memory enhancement, circulation, antioxidant
Taraxacum officinale	Dandelion	Leaves, roots	Herbal infusion, decoction	Liver support, diuretic, detoxification
Plantago major	Plantain	Leaves	Poultice, infusion	Wound healing, insect bites, skin irritation
Centella asiatica	Gotu kola	Leaves	Extract, capsule	Cognitive function, wound healing, skin health
Cinnamomum verum	Cinnamon	Bark	Powder, infusion	Blood sugar regulation, anti-inflammatory, digestion
Valeriana officinalis	Valerian	Roots	Tincture	Sleep aid, anxiety relief, relaxation
Achillea millefolium	Yarrow	Leaves, flowers	Herbal infusion	Digestive aid, menstrual support, wound healing
Sambucus nigra	Elderberry	Berries	Syrup, extract	Immune system support, cold and flu relief
Urtica dioica	Nettle	Leaves, roots	Infusion, decoction	Allergies relief, joint pain, diuretic
Panax quinquefolius	American ginseng	Roots	Tea, extract	Energy booster, immune support, cognitive function
Arctium lappa	Burdock	Roots, leaves	Decoction, poultice	Blood purification, skin health, liver support
Ginkgo biloba	Ginkgo	Leaves	Capsule, extract	Cognitive function, memory enhancement, circulation
Foeniculum vulgare	Fennel	Seeds	Herbal infusion	Digestive aid, colic relief, menstrual support
Rhamnus purshiana	Cascara sagrada	Bark	Decoction	Constipation relief, digestive health
Althaea officinalis	Marshmallow	Roots, leaves	Herbal infusion	Soothing sore throat, digestive aid, skin irritation
Taraxacum mongolicum	Mongolian dandelion	Whole plant	Herbal infusion	Liver support, diuretic, detoxification
Eucalyptus globulus	Eucalyptus	Leaves	Inhalation, essential oil	Respiratory health, congestion relief, immune support
Silybum marianum	Milk thistle	Seeds	Capsule, extract	Liver support, detoxification, antioxidant
Astragalus membranaceus	Astragalus	Roots	Decoction	Immune system support, energy boost, stress reduction
Mentha spicata	Spearmint	Leaves	Herbal infusion	Digestive aid, nausea relief, respiratory support
Curcuma aromatica	Wild turmeric	Rhizomes	Powder	Anti-inflammatory, digestive aid, wound healing
Withania somnifera	Ashwagandha	Roots, leaves	Capsule, extract	Stress reduction, energy booster, immune support
Filipendula ulmaria	Meadowsweet	Flowers	Herbal infusion	Pain relief, anti-inflammatory, digestive aid
Leonurus cardiaca	Motherwort	Aerial parts	Tincture, infusion	Menstrual support, anxiety relief, cardiovascular health
Arctostaphylos uva-ursi	Uva-ursi	Leaves	Infusion	Urinary tract health, diuretic, antibacterial
Hypericum perforatum	St. John's wort	Aerial parts	Infused oil	Mood support, nerve pain relief, wound healing
Melissa officinalis	Lemon balm	Leaves	Herbal infusion	Stress reduction, sleep aid, digestive support
Passiflora incarnata	Passionflower	Aerial parts	Herbal infusion	Anxiety relief, sleep aid, relaxation
Mentha piperita	Peppermint	Leaves	Essential oil	Digestive aid, headache relief, respiratory support
Calendula officinalis	Calendula	Flowers	Oil infusion	Skin healing, anti-inflammatory, wound treatment
Ocimum basilicum	Basil	Leaves	Herbal infusion	Digestive aid, respiratory health, stress reduction
Equisetum arvense	Horsetail	Aerial parts	Infusion	Hair and nail health, diuretic, wound healing
Passiflora incarnata	Passionflower	Aerial parts	Herbal infusion	Anxiety relief, sleep aid, relaxation
Curcuma zedoaria	Zedoary	Rhizomes	Powder	Digestive aid, anti-inflammatory, detoxification
Alchemilla vulgaris	Lady's mantle	Aerial parts	Infusion, poultice	Menstrual support, wound healing, digestive aid
Ginkgo biloba	Ginkgo	Leaves	Capsule, extract	Cognitive function, memory enhancement, circulation
Sambucus nigra	Elderberry	Berries	Syrup, extract	Immune system support, cold and flu relief
Salvia officinalis	Sage	Leaves	Infusion	Sore throat relief, antimicrobial properties
Plantago major	Plantain	Leaves	Poultice, infusion	Wound healing, insect bites, skin irritation
Rhamnus purshiana	Cascara sagrada	Bark	Decoction	Constipation relief, digestive health
Eucalyptus globulus	Eucalyptus	Leaves	Inhalation, essential oil	Respiratory health, congestion relief, immune support
Filipendula ulmaria	Meadowsweet	Flowers	Herbal infusion	Pain relief, anti-inflammatory, digestive aid
Alchemilla vulgaris	Lady's mantle	Aerial parts	Infusion, poultice	Menstrual support, wound healing, digestive aid
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Filipendula ulmaria	Meadowsweet	Flowers	Herbal infusion	Pain relief, anti-inflammatory, digestive aid
Equisetum arvense	Horsetail	Aerial parts	Infusion	Hair and nail health, diuretic, wound healing
Alchemilla vulgaris	Lady's mantle	Aerial parts	Infusion, poultice	Menstrual support, wound healing, digestive aid

Conclusion

Preserving traditional medicine relies on conserving herbal plants and knowledge. Ethnobotany explores ethnic communities' role in identifying natural resources. Ayurvedic medicines use 70% plants, 20% minerals, and 10% animal products for wound healing. *Pteridophytic* plants with antimicrobial properties are under-researched in ethno-medicine. The study documented botanical and local names, parts used, preparation methods, and ethno-medical uses. Unaware of ecological significance, locals exploit medicinal plant species. Despite traditional healers' age, 75% still rely on accessible herbal preparations.

A study examined *Pteridophyte* species as vegetables and herbal medicine. Reports note 305 genera and 10,000 species worldwide. Only healers, herbalists, and rural residents know medicinal plants. Rural areas rely on plants for ailments like colds, coughs, fevers, headaches, and more. As interest in herbal medicine grows, there are more chances to study the medicinal and other properties of natural products that were previously hard to access. In the 21st century, herbal drugs and products are essential for life, and discovering useful plant-derived chemicals for therapy involves combining ethnobotany, phytochemistry, medicinal chemistry, and pharmacology. Future discoveries depend on sustainable plant exploration, and herbal harvesting should be done in a way that doesn't harm the environment.

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