MINI REVIEW

Medicinal Plants: The Rising Strategy for Synthesis of Modern Medicine

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Abstract

The knowledge of the medicinal properties of the plants is rooted back in the cultural transmission of historic traditions, and beliefs of the inhabitants of a given geographical area, and in the ancient texts, literature such as Ebers Papyrus, De Materia Medica. The ethnic communities such as Bhotiya residing in the Byans valley of West Himalaya, India; Chin indigenous group of Myanmar still customize their herbal formulations from different plant parts depending upon the types of disease for disease prevention and treatment. However, with the change in consumer behavior, the pharmaceutical industries are gaining interest in the formulation of modern medicines based upon natural plant extracts, or the isolated bioactive compounds.

Keywords: Healthcare, Herbal products, COVID-19, Formulations, Complementary medicines

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Introduction

Humans have been dependent upon the plants present in their surroundings for fuel, clothing, shelter, food, and many more. Various civilizations across different countries such as China, Egypt, India, and Greece have been utilizing medicinal plants for disease prevention and treatment, as a disinfectant (Jamshidi-Kia *et al*., 2018). The use of plant-based products such as oil extracted from *Papaver somniferum* L., *Glycyrrhiza glabra* L. was evident in Mesopotamia around 2600 BC (Adhikari and Paul, 2018). The strength of ancient human civilization i.e., symbiotic relationship with the natural environment, and traditional knowledge was passed on to generations which now seems to play a key role in the development of current healthcare system. A global shift towards plant-based medicines in the form of herbal products is trending as it is the oldest form of healthcare ever reported to mankind (Negi *et al*., 2018). The Indian traditional medicine system is still being practiced in the healthcare system across rural areas which is based on Unani, Ayurveda, and Siddha (Vineeta *et al.,* 2022). As per the World Health Organization (WHO), the plant material naturally obtained and are used at least or under the lack of industrial processing for disease treatment either at a regional or local scale can be referred to as traditional medicinal plants (Jamshidi-Kia *et al*., 2018). The traditional knowledge associated with the medicinal plants is localized in the context of socio-cultural value, and time especially among the indigenous or rural communities (Vineeta *et al.,* 2022). This review provides critical analysis about the ancient texts available for the medicinal plants, the importance of medicinal plants in combating the COVID-19 pandemic, accompanied by case-studies in reference to Indian and international (Myanmar) context to highlight the usage, and practices of medicinal plants among tribal communities for disease treatment and prevention. The status of medicinal plants across globe focuses to provide a list of medicinal plants used across different countries, present and the future prospects deals with the utilization of medicinal properties of plants in modern medicine with examples of existing plant-based medicines.

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Ancient Texts: Medicinal Plants

One of the oldest text based on medicinal plants was written by an emperor Shen-Nung in around 2700 BC that contains a list of drugs for each day of the year (Kesharwani *et al*., 2019). Despite a long culture of phytotherapy, the texts peculiar to the medicinal plant's usage were destroyed with the destruction of Castles of the Ismailis, and during the fire incident at the library of Alexandria. The first reported book addressed greater than 700 plant-derived drugs, and medicines in the texts of Ebers Papyrus, which was written in 1500 BC. In India, China, and Egypt the scripts on medicinal plants have been known for 5000 years. The Indian literature consists of texts written by Charaka and Sushruta Samhitas that separately contain information on 341 and 395 herbal medicines, respectively (Adhikari and Paul, 2018; Jamshidi-Kia *et al*., 2018). Pedanius Dioscorides wrote an encyclopedia entitled "De Materia Medica" in 75-45 BC that contains the description of 600 therapeutic medicinal plants**.** In terms of practicing the art of traditional medicine, Chinese and Indian traditional knowledge of medicinal plants leads the world (Jamshidi-Kia *et al*., 2018). The traditional medicine practices are applied in rural areas where the modern healthcare system is yet to reach. However, in areas where modern healthcare practices are available a significantly large population is dependent on the Unani or Ayurvedic system. Various cosmetic companies are shifting back to the search of more sophisticated products through the literature survey of ancient texts (Anand *et al.,* 2022).

The prevention and treatment for type 2 diabetes mellitus in traditional Chinese medicine was based on berberine, an active compound of *Coptis chinensis* rhizomes. Thereby, the ancient texts have provided a new pathway for the berberine as anti-diabetic compounds which is under the regulatory pipeline for clinical trials (Wang *et al*., 2018).

Medicinal Plants Served as A Boon During the Global Crisis of the COVID-19 Pandemic

The origin of COVID-19 cases in the early December in Wuhan city, China; was marked as a pandemic on 11 March 2020 by WHO owed to the fatality risk, and the rate of transmission worldwide. In the past few years, the COVID-19 pandemic has cost citizens across the globe in terms of economic loss and human tolls. As per the reports of the World Travel and Tourism Council, an overall 25% decrease in global travel was observed during 2020. While the full-time job loss count jumped from 130 to 300 million from the first to the second quarter of 2020 (Padhan and Prabheesh, 2021). As per the annual report of 2020-21 by the Indian MSME Ministry, the 6.3 crore micro-enterprises were the most vulnerable during the pandemic attributed to the small size of the operating unit, and very low savings to support the cash cycle of business. Thereby, the Indian government decided to introduce Rs. 20,000 crores as a subordinate debt for MSME, and an equity purchase through MSME fund of funds for Rs. 50,000 crores. Also, the Government of India along with the Reserve Bank of India infused Rs. 15,700 crores in the Union Budget 2021-22 (Singh *et al*., 2022). However, even after economic support to people by the government, the rising covid cases were still detrimental for the growth of society. At the time of the ongoing race for the vaccine development, Patanjali launched an Ayurvedic medicine named Swasari, and Coronil for the treatment of patients infected with covid. Coronil was developed from the extracts of Tulsi (*Ocimum sanctum*), Giloy (*Tinospora cordifolia*), and Ashwagandha (*Withania somnifera*). Giloy aids in the detoxification, purification of blood, and bacterial fight; Tulsi helps in reducing the pain, stress, fever, cough, and acts as a natural immune booster; Ashwagandha is rich in antibiotics and aid in reducing the stress (Durafe, 2020). The compositional analysis of Coronil revealed the phytochemical constituents such as polyphenols (rosmarinic acid), terpenoids (betulinic and ursolic acid) from *Ocimum sanctum*; alkaloids (Magnoflorine, Palmatine, furan glycoside, cordifolioside A) from *Tinospora cordifolia*; steroidal lactones (Withaferin A, Withanoside IV, V, and Withanone) from *Withania somnifera*. In addition, the tinocordiside, and withanone the key phytochemicals of Coronil hamper the ACE-2 receptor, and SARS-CoV-2 S protein interaction in a dose-dependent manner (Balkrishna *et al.,* 2021). However, the company's claim for Coronil based on the results of 100% recovery rate during 7 days treatment against COVID-19 with Patanjali Ayurvedic Medicine, decrease in IL-6 (indicating low chances of cytokine storm), and C-reactive protein levels for the cure of COVID-19 patients within 3–14 days as compared to placebo group has put multiple controversies in the medical fraternity. As a result, the Ministry of Ayush, India permitted the Patanjali group to sell Coronil only if they advertise it as an immune-booster drug with no specification related to the COVID-19 cure. The company was permitted to sell the product under the label displayed as "Divya Swashari Vati" and "Divya Coronil Tablet." The ayurvedic remedies and the home-based medicines were the only remedies available during the COVID-19 pandemic before the launch of the vaccine (Durafe, 2020; Mukherjee, 2021).

Medicinal Plants Utilization in Byans Valley in Kailash Sacred Landscape, India

The Himalayan region in India is well known for its diversified ethnic culture and richness of medicinal plants. The richness of the Indian Himalayan region can be evidenced by the diversity in terms of 44 gymnosperms; 8,000 angiosperms; and 600 pteridophyte species; of which a total of 1,748 species have been reported with certain medicinal uses. A study across the seven migratory villages inhabited by an ethnic community named Bhotiya, a Mongoloid-based community consisting of the trans-border traders in the Byans Valley of Pithoragarh district in West Himalaya reported the presence of 53 plants species with the usage in disease treatment. Out of 27 reported different families the healthcare practitioners dominantly used the species belonging to the Rosaceae family followed by Asteraceae, Liliaceae, Plygonaceae, Lamiaceae, and Ranunculaceae. The frequency of usage of different plant parts such as maximum usage of roots and underground parts is based on the kind of disease that has to be cured and the presence of different compounds. A wide number of plants are used to cure diseases such as for cough and cold- *Abies pindrow, Allium stracheyi, Sassurea costus*; for cuts, wounds, and burns- *Pinus wallichiana, Rheum webbianum, Podophyllum hexandrum*; for digestive disorder- *Carum carvi, Thalictrum minus*; for headache or fever- *Malus baccata, Bistorta affinis, Jurinea dolomiaea*; for jaundice- *Allium stracheyi, Picrorhiza kurrooa, Nardostachys grandiflora*; for skin diseases- *Juniperus communis, Origanum vulgare, Artemisia nilagirica*; for Rheumatism- *Impatiens balsamina, Aconitum violaceum* are used. To continue the widespread of traditional practices, the rural communities have formulated a unique methodology for the management of forests and pastures through the promotion of sacred forests, pastures, and grooves (Negi *et al*., 2018). The continuous transmission of knowledge to the upcoming generations has maintained the formulations for current, and future usage.

Herbal Formulation, and Protection by Three Chin Indigenous Groups in Natma Taung National Park in Myanmar

Natma Taung National Park (NTNP), Myanmar's protected area includes the three State townships of Southern Chin of Mindat district with very high cases of poverty, insufficient food, and poor medical facilities. A survey across three Chin ethnic groups- Müün, Ng'gah, and Daai inhabiting around and within NTNP in 20 villages documented a total of 75 wild medicinal species belonging to 40 different plant families, that were used in 260 different herbal formulations to cure approximately 90 different

Table 1: A list of medicinal plant species, family, country, and the part used for disease treatment

Medicinal plant species	*Family*	*Country*	*Part used*	*Disease Treatment*	*References*
Ocimum sanctum	Lamiaceae	India	Inflorescence	Nausea, Flu, cold, asthma	Poddar *et al*., 2020
Cinnamomum zeylanicum	Lauraceae	India	Bark	Diabetes, cough, diarrhea	Poddar *et al*., 2020
Phyllanthus emblica L.	Euphorbiaceae	India	Fruit	Influenza A, hair tonic	Gangal *et al*., 2020
Andrographis paniculata	Acanthaceae	India	Stem, leaves	Influenza A, Hepatitis B and C, Herpes, Chikungunya virus	Gangal *et al*., 2020
Curcuma longa	Zingiberaceae	India	Rhizome	Zika virus, human papillomavirus	Gangal *et al*., 2020
Zingiber officinale	Zingiberaceae	India	Roots, rhizome	Cold and cough	Gangal *et al*., 2020
Tinospora cordifolia	Menispermaceae	India	Stem	Diabetes, allergy, inflammation	Gangal *et al*., 2020
Glycyrrhiza glabra	Fabaceae	India	Roots	Cold and cough, upper respiratory infection	Gangal *et al*., 2020
Withania somnifera	Solanaceae	India	Roots, leaves	Herpes simplex virus	Gangal *et al*., 2020
Cuscuta reflexa Roxb.	Convolvulaceae	India	Whole plant	Jaundice	Bamola *et al*., 2018
Nerium oleander L.	Apocynaceae	India	Latex of plant	Muscle pain in limbs	Bamola *et al*., 2018
Ricinus communis L.	Euphorbiaceae	India	Root	Wounds, skin diseases	Anand *et al*., 2022
Plumbago zeylanica L.	Plumbaginaceae	India	Root, bark	Ringworm, and leucoderma	Anand *et al*., 2022
Euphorbia milii	Euphorbiaceae	India	Whole plant	Cancer, and Hepatitis	Kumar *et al*., 2021
Pyrus communis L.	Rosaceae	India	Leaves, Bark	Inflammation, sprain	Kumar *et al*., 2021
Tinospora sinensis	Menispermaceae	Myanmar, India	Root, stem	Dyspepsia, paralysis	Kyaw *et al*., 2021
Chromolaena odorata	Asteraceae	Burma	Whole plant, leaves	Cough, fever, cuts, and wounds, tuberculosis	Kyaw *et al*., 2021
Tadehagi triquetrum	Fabaceae	Myanmar	Whole plant, leaves	Dysuria, asthma, tuberculosis	Kyaw *et al*., 2021
Alysicarpus vaginalis	Fabaceae	Myanmar	Whole plant	Gall stones, dysuria	Kyaw *et al*., 2021
Cannabis sativa	Cannabaceae	Pakistan	Leaves, seeds	Chest pain	Birjees *et al*., 2022
Alcea rosea L.	Malvaceaea	Pakistan	Flowers	Dandruff	Birjees *et al*., 2022
Shorea robusta	Dipterocarpaceae	Nepal	Branch	Gingivitis, bleeding gums, bad breath	Rajbanshi & Thapa, 2019
Allium cepa L.	Amaryllidaceae	Italy	Bulbs	Galactagogue, cystitis	Motti *et al*., 2019
Humulus lupulus L.	Cannabaceae	Italy	Leaves	Dysmenorrhea	Motti *et al*., 2019

illness distributed across the 16 categories of diseases. The various other medicinal plants and their parts that are commonly used in different countries for disease treatment are listed in Table 1. Of all the families reported, Fabaceae represented the highest proportion of medicinal plants, while Lauraceae, Asteraceae, and Fabaceae represented the largest usage in 22, 21, and 20 herbal formulations respectively. Depending upon the usage of plant parts for disease treatment the leaves were highly preferred followed by roots, barks, and fruits. The internal application of herbal formulation was more preferred than the external usage, accompanied by higher use of single species in the treatment as compared to the formulation derived from a combination of different components. The reports indicated the maximum use of *Pinus kesiya* i.e., in a total of 13 different formulations for the treatment across 7 disease categories. The melted resin of *Pinus kesiya* was used in the treatment of cancer, as an antiseptic for umbilical cord stump, and as pain-ointments for rheumatoid. Similarly, the decoction prepared from the bark of *Prunus cerasoides* has been traditionally used in the treatment of diarrhea attributed to its antispasmodic, and antibacterial properties. The flowers of *Rhododendron arboreum* are used in the preparation of healthy wines, as well as a drink for the festival purpose. To protect the plant species, the local communities have devised a strategy "taungya" that inculcates the cultivation of vegetable crops close to the seedling of timber or fruit trees until a closed canopy is formed by the trees; after-that farmers are expected to shift to another degraded managed forest reserve or state-owned land (Ong *et al*., 2018).

Present, and Future Prospects

Currently, the wide array of the utilization of medicinal plants is largely limited to the wildlife arena. It is evident with a reported increase in demand for wildlife resources by 8–15% per year

across Asia, North America, and Europe (Jamshidi-Kia *et al*., 2018). Currently, 90% of the pharmaceutical demand for plant species is met by wild medicinal plants from the alpine, and sub-alpine regions of the Himalayas (Negi *et al.,* 2018). As per WHO reports greater than 80% of the world population relies on plant-based traditional drugs. The plant parts such as seeds, roots, leaf, fruit, flower, or the complete plant can be used for therapeutic or medicinal purposes (Jamshidi-Kia *et al*., 2018). More than 40% of Americans and 20-60% of Europeans currently utilize traditional medicine as complementary or alternative medicine (Adhikari and Paul, 2018). The use of traditional drugs is increasing especially in the industrialized countries under the tag of alternative or complementary medicines (Jamshidi-Kia *et al*., 2018). The annual worth of the global medicine market ranges to about 1.1 trillion US dollars. The natural product market in medicine is almost 35% of which 25% is contributed by the plants as a direct therapeutic agent source or raw material for the development of new products in combination, or to design the lead bioactive molecule which can be then synthesized through a semi-synthetic technology (Calixto, 2019).

The scientific analysis of the different plant parts used in traditional drugs in terms of chemical structure, pharmaceutical properties, and clinical trials has laid down the foundation of multiple drugs. The pharmaceutical industries emphasize on analysis and isolation of compounds from the medicinal plants that have a rich history/reports/literature in successful treatment of disease. The knowledge gathered from different sources is cumulated for the development of a new formulation that are ready to use, with a longer shelf-life, and a high efficacy for disease treatment. The increasing use of herbal products in modern medicine can be evidenced by the Nobel Prize awarded in Physiology or Medicine in 2015 to Tu Youyou for the development and discovery of an antimalarial drug- artemisinin, derived from the *Artemisia annua*. The compound derived from *A. annua* has been previously used by the East Jin Dynasty of Chinese culture between 317 and 420 AD for the treatment of malarial symptom-periodic fevers. Tu Youyou succeeded in the extraction of the non-toxic compound with a high efficacy through the low-temperature technique used in ancient times for the herb preparation (Wang *et al*., 2018).

The drugs currently sold in the market such as Morphine is derived from the *opium poppy*, Aspirin is derived from the bark of willow, and Quinine from the skin/bark of the *Cinchona* sp. tree, Digoxin is derived from the Foxglove (Jamshidi-Kia *et al*., 2018). Acheflan, an anti-inflammatory, and the analgesic product is derived from the essential oil extracted from *Cordia verbenacea*. Melagrião, a remedy for cough and asthma marketed by Catarinense Pharma (Brazil) is derived from *Mikania glomerata* leaves. Similarly, Syntocalmy, marketed by Aché Laboratorios a product for anxiety and insomnia treatment is derived from *Passiflora incarnata* leaves (Calixto, 2019). There are many other products that are derived from the traditional medicines such as OraMagic Rx, a commercial product prepared from *Aloe vera* to treat cold sores, psoriasis; Ellura made from berry fruits to treat urinary tract infection. VP-Precip is prepared from flaxseed oil, bilberry extract, and evening primrose oil; Vitadirect Turmeric Plus is prepared from *Turmeric curcumin*, curcuminoids to be effective as an anti-inflammatory product. Pineapple juice that was earlier consumed by the American Indians to heal skin injuries and inflammation has helped to isolate the enzymes that break down the bromelain proteins, and blood clots (Kesharwani *et al*., 2019). Thereby, the knowledge of traditional medicine when combined with scientific attributes can be processed and refined towards the new novelties and proprietary medicines for the modern world.

Conclusion

Medicinal plants have a rich history since ancient civilization which is still being passed on to the upcoming generations for the welfare of humankind. However, the techniques associated with the usage, and extraction of specific extract from medicinal plants is limited to specific region. The increasing search for new and better medicines has brought back the pharmaceutical companies to roots of ancient texts associated with the medicinal plants. Moreover, with COVID-19 pandemic a tremendous shift from the synthetic to plant-based products has led to greater scientific analysis behind the usage of plant-based products. Therefore, the integration of traditional knowledge of medicinal plants across the world with the art of modern medicine is untapped and has the potential to become a full blooming industry.

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