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Review Article

Importance of Medicinal Plants in Human and Plant Pathology: A Review

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ABSTRACT

Natural substances obtained from medicinal plants (MPs) and their plant extract (PEs) are used for the treatment of a lot of diseases in human pathology as well as plant pathology. So, it is importance to understand a golden relationship between man and his environment. The research work and application of MPs and PEs in the treatment of human and plant diseases is increasing day by day. Before the development and civilization in the world, MPs were traditionally used as a therapeutic agent for the remedy of various diseases such as typhoid, gonorrhea, measles and cholera. However, the knowing about the MPs for cure of diseases is confined to plant scientists or herbalists and it is believed that MPs and PEs will lose their potency if revealed to other people. In case of plant pathology, the overuse of synthetic and chemical bases fungicides and other pesticides are the main threat to the sustainable environment. Therefore, we should move towards MPs and PEs in case of both human pathology as well as in plant pathology. In this review, we will about medicinal uses of plants in past as well as in now a day for the management of various diseases.

Keyword: *Medicinal Plants; Plant Extracts; Medicinal Herbs; Phytochemicals; Polyphenols; Synthetic Fungicides; Antifungal Nature.*

INTRODUCTION

Plant, being main source of various medicine, plays an important and significant role in the health of both plant as well as human. Various herbs and plants are well known for curative as well as therapeutics aids.

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In health system, the application of various plants as a Medicinal Plants (MPs) has attained key importance in all over the world, in case of both plant (Rehman et al., 2020) and humans (Ali et al., 2021). The MPs are not only used for the treatment of diseases of humans and plants but also are the important source of materials that maintain the good health and conditions of body. For primary health care, about 2/3rd of the population of world relays on the use of MPs for HMs. The better adaptability and compatibility of MPs with the human body i.e. have less side-effects and better cultural acceptability give great importance to MPs in medicinal field. It has been demonstrated that the most of used drugs have PEs as a main ingredient. Many of them have bioactive component that are extracted from plants as active ingredients. Through various researches, the medicinal activities of MPs have been discovered from the study of traditional and therapeutic cures. The most common knowledge of man and his claims and believes have made a lot of advancement in the field of science and technology. The most of the common drugs that are believed to be obtained from PEs are atropine, vinblastine, artimesinin, tubocurarine, digoxin, pilocarpine, quinidine, physostigmine, morphine, reserpine, ephedrine, taxol, colchicine, vincristine, quinine and aspirin. The great importance of MPs cannot be ignored in all over the world. It is the desired need to study the characteristics and key importance of phytochemicals in all of the MPs.

Since old times, MPs, that are also known as medicinal herbs, have been used in traditional medicinal techniques. Various species produce a lot of chemical compounds that protect them from insects, diseases and herbivorous mammals, among other things. A lot of phytochemicals have been reported as having biological activities at potential level. The results of using a whole plant as medicine, however, are unclear since a single plant contains a wide variety of phytochemicals. Furthermore, several medicinal plants have phytochemical content and pharmacological behavior, if any, remain uncertain due to a lack of comprehensive scientific studies to establish efficacy and protection (Ahn, 2017). The early historical documents of herbs can be found on clay tablets since the Sumerian Civilization, which report many of MPs, including opium. Over 850 MPs are described in the Ebers Papyrus from ancient Egypt, which dates from around 1550 BC. In De materia medica, that is as old as 60 AD, the Greek physician Dioscorides reported over 1000 methods for HMs using over 600 species of MPs; this served as a foundation for pharmacopoeias for about more than 1500 years. Ethnobotany is used in drug testing to scan for substances that are pharmacologically active in nature, and it has resulted in the discovery of many of useful compounds. Aspirin, digoxin, quinine, and opium are just a few examples. Plants contain a wide range of compounds, but the majority belongs to one of four biochemical groups including alkaloids, glycosides, terpenes and polyphenols.

In non-industrialized and traditional cultures, MPs are most commonly used, largely because they are easily available and less costly as compared to modern medicines. In 2012, the global export values of a lot of MPs species suspected of having medicinal values was projected to be 2.2 billion American dollars (Anonymous, 2017). The global demand for PEs and medicines was projected to be worth several hundred billion dollars in 2017 (Ahn, 2017). Traditional medicine remains unregulated in many nations, but the WHO coordinates a network to facilitate healthy and fair use. Both common risks, such as climatic and environmental change and habitat loss, and the particular danger of huge-collection to meet consumer needs face MPs (Ahn, 2017). Various Secondary Metabolites (SMs) are produced by plants which are very important for developmental processes of plants (Rosenthal et al., 1991). These SMs are toxic in nature and have great potential against microbial pathogens (Schafer et al., 2009). The application of plant based pesticides against the pre-harvest and post-harvest diseases are one of the feasible methods. The use of MPs

against the plants diseases lead to ecofriendly control of diseases. The PEs which have SMs act as rich source of natural compounds which have the fungicidal and other properties. They have less side effects. The antifungal activity of many of PEs is more as compared to some commercially available and synthetic fungicides. These PEs are naturally produced in MPs and have great anti-fungal as well as antu-bacterial properties (Tamuli, 2014). That is why, it is very important to adopt ecofriendly and environmentally safe management practices in plant pathology. In this review, various in-vitro studies have been reviewed to cope with the human as well as plant pathogens.

2. History

2.1 Prehistoric period

Plants, that are used as spices and culinary herbs, have been used as a source of medicines since prehistoric times, but not always successfully. Spices have been used to combat bacteria that cause food spoilage, commonly in hot environmental conditions (Billing et al., 1998; & Tapsell et al., 2006) and in meat dishes that spoil more easily (Sharma et al., 2001). The majority of HMs originated from angiosperms (flowering plants) (Anonymous, 1993). Weeds used as MPs, such as *Urtica dioica*, Taraxacum, and *Stellaria media*, are often found surrounding human settlements (Stepp & John, 2004; & Stepp et al., 2001). Humans aren't the only ones that use herbs as medicine: Monkeys and apes, *Danaus plexippus*, and *Ovis aries* eat MPs when they are sick. The PEs from old burial sites are one line of evidence that people of Paleolithic time were also familiar with HMs. For example, pollen from eight plant species was found in large quantities at the Neanderthal burial site (which are 60,000-year-old) "Shanidar IV" in northern Iraq, 7 of which are now used as HMs (Solecki & Ralph, 1975). A mushroom was also discovered in belongings of Otzi the Iceman, whose dead body had been frozen for more than 5,000 years in Otztal Alps. The mushrooms were most commonly used to cope with whipworm (Tunón & Svanberg, 1999).

2.2. Ancient Time

Hundreds of MPs, namely opium and myrrh, were mentioned on clay tablets in Sumeria of ancient time. Over 800 HMs are mentioned in the ancient Egyptian Ebers Papyrus, including juniper, garlic, aloe, hemp, mandrake and castor bean (Sumner & Judith, 2000). Many of pharmacologically active spices and herbs, such as *Curcuma longa*, which contains (1E,6E)-1,7-bis (4-hydroxy- 3-methoxyphenyl) -1,6- heptadiene-3,5-dione, have been used in Ayurvedic medicine from very old times to the present, as recorded in the Rig Veda, the Atharva Veda, and the Sushruta Samhita (Aggarwal et al., 2007). The Shennong Ben Cao Jing, a Chinese pharmacopoeia, mentions HMs like chaulmoogra for ephedra, leprosy and hemp. Yaoxing Lun of the Tang Dynasty expanded on this. Theophrastus, who was the student of Aristotle, was the writer of the first systematic book on botany, Historia plantarum, in fourth century BC (Grene & Marjorie, 2004). In his book De materia medica, written for the Roman army about 60 AD, Greek physician named Pedanius Dioscorides recorded more than 1000 methods for HMs by using more than 600 MPs. For over 1500 years, until seventeenth century, the book was definitive guide on herbalism (Collins & Minta, 2000).

2.3. Middle Ages

The medical knowledge was maintained by Benedictine monasteries in Europe in the early middle ages by interpreting and copying the original texts and preserving herbal and natural gardens (Arsdall & Anne, 2002). On HMs, the Causae et Curae ("Causes and Cure") was written by Hildegard of Bingen (Ramos-e-Silva Marcia, 1999). A lot of old Greek texts, i.e. Dioscorides, were translated into Arabic during the Islamic Golden Age, with scholars putting their knowledge. Herbalism grew in popularity in the Islamic countries, mainly in Al-Andalus and Baghdad. Abulcasis (936–1013) from Cordoba wrote a Book of Simples and Ibn al-Baitar mentioned hundreds of HMs in his Corpus of Simples, including Aconitum, nux vomica, and tamarind (Bajpai & Agarwal, 2015) Several plants were used in Avicenna's

book named as The Canon of Medicine. Further pharmacopoeias were written by Ibn Zuhr, John of St Amand, Peter of Spain and Abu-Rayhan Biruni (Brater et al., 2000).

2.4. Early Modern

Beginning with the 1526 Grete Herball, illustrated herbals flourished across Europe during the Early Modern era. In 1597, focusing on Rembert Dodoens, John Gerard published General History of Plants or The Herball, and Nicholas Culpeper published a book The English Physician Expanded (Singer & Charles, 1923). At the time of Early Modern discovery, many natural HMs originated in Europe and the Columbian Trade, which saw animals, seeds, and technology traded between Americas and the Old World in the 15th and 16th centuries. Garlic, ginger, and turmeric were among the MPs that arrived in the Americas, while tobacco, coffee, and coca went into the other direction (Nunn & Qian., 2010). The Badianus Manuscript, written in Mexico in the 16th century, described MPs found in Central America (Millie, 2008).

2.5. Nineteenth and Twentieth Centuries

Chemical analysis changed the value of plants in medicine dramatically in the nineteenth century. Starting with morphine which was obtained from the poppy in 1806, alkaloids were derived from a variety of MPs, including strychnos and ipecacuanha in 1817, quinine obtained from the cinchona flower, and several others. Many more groups of phytochemicals were identified in MPs as chemistry developed. Merck began extraction of distilled alkaloids from MPs at commercial level, including morphine, in 1826. Salicylic acid was the first drug synthesized since it was found in a MPs in 1853 (Atanasov et al., 2015). At the end 19th century, the atmosphere in the pharmacy shifted toward MPs, many of the enzymes often changed their activeness when the plants were dried, and glycosides and alkaloids obtained from plant material began to be favored. Plant-based drug research remained strong during the nineteenth and twentieth century, with anti-cancer drugs of great importance were derived from Madagascar periwinkle and yew (Atanasov et al., 2015).

3. Phytochemical Basis

Many plants develop different chemicals that give them an evolutionary benefit, such as defensive from herbivores or in plant defenses by acting as hormones, as in the case of salicylic acid (Hayat & Ahmad, 2007). It was scientifically verified, the listed and documented activity of these phytochemicals in MPs is the scientific basis for their application in medicine pharmacologically (Ahn, 2017). Daffodils (Narcissus) have 9 different classes of alkaloids, mainly including galantamine, which is approved for its application in the treatment of Alzheimer's disease. The alkaloids, having bitter taste and toxic in nature, are present in large amounts in areas of the plant that are most likely to be consumed by herbivores, such as the stem; they also can protect from parasites. The MPs Transcriptomics Database, which produced a sequence guide for the transcriptome of 30 different species by 2011, is being systematized (Soejarto, 2011). The main groups of phytochemicals which are pharmacologically active in nature are given below (Table No. 1) with examples of different MPs in which they are present (Cravotto et al., 2010).

3.1. Alkaloids

Alkaloids, which are bitter in taste and toxic in nature, are the chemicals found in many MPs that are widely distributed in nature. There are many groups of alkaloids that have different modes of action as drugs, both pharmaceutically and recreationally. Scopolamine, Atropine and Hyoscyamine are obtained from few members of nightshade (Aniszewski & Tadeusz, 2007), berberine obtained from plants like Berberis and Mahonia, caffeine (*Coffea arabica*), cocaine (*Erythroxylum coca*), ephedrine (*Ephedra sinica*), morphine (*Papaver somniferum*), nicotine (*Nicotiana tabacum*), quinidine and quinine (*Catharanthus roseus*) (Elumalai et al., 2012).

3.3. Glycosides

The MPs that produce anthraquinone glycosides include Alexandrian, senna, rhubarb, and cascara (Wang et al., 2013). Plant-based laxatives obtained from MPs include rhubarb, senna, and Aloe vera (Elumalai et al., 2012). Cardiac glycosides are potent medicines derived from MPs such as lily and foxglove of the valley. They mainly include digitoxin and digoxin, both of which function as diuretics and are helpful in normal heart beat.

3.4. Polyphenols

Polyphenols are phenolic compounds that are found in plants. Polyphenols come in a variety of groups and play a variety of roles in plant defenses mechanisms against diseases and predators, including phytoestrogens, hormone-mimicking and astringent tannins (Elumalai et al., 2012). MPs containing phytoestrogens have been used for centuries for gynecological disorders, such as menopausal problems, menstrual and fertility (Muller-Schwarze & Dietland 2006). These MPs are *Angelica archangelica*, *Pueraria mirifica*, *Pueraria montana*, *Foeniculum vulgare*, and *Pimpinella anisum* (Puleo, 1980). A lot of polyphenolic PEs, like obtained from Vitis seeds, *Olea europaea* or *Pinus pinaster*, are sold as cosmetics and dietary supplements without legal health claims or proof for beneficial effects on health. In Ayurveda, the astringent rind of the *Punica granatum* is used as a HMs because it contains polyphenols i.e. punicalagins (Jindal & Sharma, 2004).

3.5. Terpenes

Terpenes and terpenoids of different forms can be present in a wide range of MPs, as well as resinous plants like conifers. They have a strong odor and are used to repel herbivores. The fragrance makes PEs very important in perfumes like rose and lavender, as well as aromatherapy (Tchen, 1965). Some have medicinal properties, such as antiseptic activity of thymol. Therefore, it was previously used as a vermifuge which is anti-worm medicine.

4. Some Dangerous Impact of Medicinal Plants

MPs that are harvested from the wild rather than being grown face both general and particular threats. Climate change and habitat destruction, as well as construction and agriculture, are both threats. Over-collection to satisfy increasing needs of medicines is a particular challenge (Kling & Jim, 2016). One example is the strain on wild populations of the Pacific yew following the discovery of effectiveness of taxol (Atanasov et al., 2015). Over-collection may be mitigated by cultivating some MPs or establishing a certification system to ensure that wild harvesting is sustainable (Kling & Jim, 2016). According to a study released by the Royal Botanic Gardens, Kew, in 2020, about 723 MPs are on the verge of extinction, owing in part to over-collection.

Table 1: Photochemistry and utilization of Some Medical Plants

S. No.	Botanical name	Local name	Common name	Phytochemical constituents	Application	References
1	*Alternanthera nodiflora*	Dagunro (Yoruba)	Joyweeds	Alkaloids, Terpenoids, Phenols	Pain Reliever	Ogu et al., 2012
2	*Kalanchoe genata*	Odundun (Yoruba)	Miracle plant	Alkaloids, Flavonoids, Phenols, Tannins	Used for treating concussion	Feka et al., 2013
3	*Cassia alata*	Asunwon (Yoruba)	Candle bush	Flavonoids, Anthraquinones, Saponins	Relieve constipation	Oladeji et al., 2016
4	*Strophanthus hispidus*	Isa (Yoruba)	Arrow poison	Flavonoids, Tannins, Steroids, Saponins	Treatment for cough	Prohp et al., 2012
5	*Pupalia lappacea*	Emi-agbo (Yoruba)	Forest Burr	Flavonoids, anthraquinones, Phenols	Treatment for sterility in women	Burtis et al., 2000
6	*Nicotiana tabacum*	Ewe taba (Yoruba)	Tobacco	Alkaloids, Flavonoids, Tannins, Terpenes	Treatment of convulsion	Ahmed et al., 2010
7	*Carica papaya*	Ibepe (Yoruba)	Pawpaw	Flavonoids, Tannins, Steroids	Relief of constipation, catarrh and abortion	Ekeke et al., 1990
8	*Byrsocarpus coccineus*	Yoruba (Ibo)	Schellent	Flavonoids, Steroids, Saponins	Treatment of sore throat and tooth-ache.	Onah el al., 2002

5. Plant Extracts and Plant Pathology

Almost all types of agricultural crops are mostly attacked by a lot of diseases and pests in all over the world. The most are pathogenic diseases are caused by fungal pathogens (Rehman et al., 2021). It has been estimated

that the fungal and bacterial diseases cause almost 50% of losses in post-harvest crops (Magro et al., 2006). Moulds have a great potential to synthesize a various enzyme, because they are omnipresent biological agents therefore, they colonize foods and cause huge economic losses (Cabral, 2013).

The fungal spoilage mostly occurs in vegetable and fruit crops because they are highly susceptible. The abiotic factors including water activity, temperature, solute concentration, atmosphere, pH and time can result in number of plant diseases that may causes the huge economic losses both in pre-harvest and post-harvest conditions. Aspergillus, Penicillium, Fusarium, and Alternaria sp. are some genera that are more vulnerable to cause huge yield loss in grain crops. They also reduce the quality of seed and feed (Magan & Aldred, 2007).

6. Drawbacks of Using Synthetic Fungicides

The application of Chemical Based Fungicides (CBFs) is the main step to control fungal pathogens, which can be pre-harvest as well as post-harvest. They affect the quality of produce at large amount (Kalsoom et al., 2020). The application of CBFs have been done since many years in order to control of plant diseases. These application of CBFs cause the development of resistance in fungal pathogens against the fungicides because of their high amount in food products. Many of these chemicals compounds are non-biodegradable and be accumulated in water, plants and soil. Although the applications of CBFs are the efficient and cheapest way to control plant diseases (Kalsoom et al., 2020). The applied concentrations of CBFs are kept low due of their harmful impacts on health and environment of human. Due of undesirable impacts of CBFs, many studies have been done in the formation of new effective fungicides based on PEs keeping in view the living beings as an alternate way CBFs (Kalsoom et al., 2020). Because it is desired need to of today to develop the alternative of these CBFs.

7. Plants Extracts as Natural Antifungals

To minimize the use of CBFs in food, many of alternative techniques such as application of PEs are in action which produce a large amount of SMs in response (). In the last few years, many researches have been done on the use of PEs because of their safe status. These Plant Based Fungicides (PBFs) can be easily decomposed, nonphytotoxic in nature and nature friendly. It has been demonstrated that PEs are obtained with different essential oils and solvents. These PEs are used as PBFs and are rich in antioxidant and bioactive compounds. It has been demonstrated that rust pustules of wheat can be reduced by using the PEs obtained from *Datura stramoniu* (Hassan et al., 1992). The great antifungal activity is exhibited by PEs of *Allium cepa* against *Ascochyta rabiei* and *Helminthosporium turcicum* and the PEs of *Calotropis procera* also show antifungal activity against *Alternaria redicina* (Khan et al., 1998). The PEs of *Adenocallima alliaceum* is also used against the spore germination of F. *oxysporum* and *A. alternata* and can completely inhibit them (Rai et al., 2000). It has been demonstrated that the PEs of three species of Asteraceous applied on growth of *A. niger* give satisfied results (Rukhsana et al., 2001). The PEs of *Eugenia aromatica* applied against *Alternaria solani* can inhibit its spore germination. The PEs obtained from garlic and onion bulbs, pepper fruits and eucalyptus leaves also give remarkable inhibition activities against *A. solani* and *S. parasitica* (Khallil, 2001). An *in-vitro* test has been done by Paul (2003) by using the PEs of *Maesalan ceolata* var. goulun gensis against *P. cryptogea*, *A. niger*, *Phoma* sp., *S. rolfsii*, *P. ultimum*, *T. virens*, *C. heterostrophus*, *F. oxysporium*, *R. solani* and *Pyrenophora* and effective results have been shown. It has been demonstrated that the brown spot of rice caused by *H. oryzae* can easily controlled by using various PEs obtained from seeds such as seed extracts of *S. indicum*, 10% rhizome extract of *C. longa* and the seed extract of *W. tinctoria* and the results were inhibition of spore germination and reduced mycelial growth (Harish et al., 2004). The PEs obtained from the roots of *R. acetosella* minimize the development of *B. graminis* of barley (Choi et

al., 2004). Out thirty-seven PEs of which *Cymbopogon citratus*, *Cinnamomum verum*, *Syzygium aromaticum*, *Cymbopogon martinii* and *Origanum vulgare* gave antifungal activities against the species of *Fusarium* (Velluti et al., 2004). Rodriguez et al. (2005) demonstrated the antifungal activity of *Aloe barbadensis* miller against mycellium growth of *R. solani*, *F. oxysporum* as well as *Colletotrichum coccodes* gave the inhibition activities against fungi. The volatile components PEs obtained from the floral parts of wax mallow, lantana and chinese hibiscus gave high antifungal activities against *A. solani*, R. *solani*, *P. ultimum*, *V. dahlia* and *B. cinerea* than PEs obtained from their leaves and stems (Boughalleb et al., 2005). It has been demonstrated that the efficacy of Milsanato induce resistance to Podosphaera xanthii on cucumbers causing the Powdery Mildew (Doltsinis et al., 2006). It has also been found that Milsana have a great importance in the better control of powdery mildew on tomato. Kumar et al., (2007) demonstrated that the PEs obtained from Mexican tea plant can inhibit *F. oxysporum*, *S. rolfsii*, *A. flavus*, *B. theobromae*, *A. fumigatus*, and *P. debaryanum*. It is also found that essential oil obtained from *Peumus boldus* is also very effective against Aspergillus flavus, Fusarium spp. and Aspergillus niger (Souza et al., 2005). Magro et al. 2006 demonstrated that the great antifungal activities against *A. candidus*, Penicillium sp., *A. niger* and *Fusarium culmorum* is present in aqueous PEs of *Matricaria chamomilla* L. and *Malva sylvestris* L. The mycelial developments of *P. chrysogenum*, *A. niger*, *P. verrucosum* and *A. flavus* were reduced by the applications of cold-pressing the peel of *Citrus limon* and *Citrus sinensis* (Viuda-Martos et al., 2008). In the experiments of Shirzadian et al. (2009) out of twenty-one species of moss and two species of leafy liverwort, the PEs extracted by using the solvents water, ethanol, and petroleum ether showed great antifungal activity against *Alternaria alternata*. Fawzi (2009) also evaluated different PEs against *F. oxysporum* which gave the inhibition of radial growth of fungi. Lakhdar (2010) demonstrated the antifungal properties of PEs in the form of PEs of some local MPs on *Fusarium oxysporum* f. sp. lentil. The soil population densities of fungi are highly reduced by the application of 10% and 5% powdered extracts of sticky fleabane and Peppermint and many of the essential oil in PEs also control the population densities of fungi in soil and the incidence of diseases in *Lens culinaris*.

CONCLUSION

The lifestyle of human being is now getting techno-savvy and he is moving away and away from nature and natural products. He doesn't know that he cannot escape from nature because he is actually the part of nature. Herbs, being the natural products, are eco-friendly, free from side-effects, locally available and comparatively safe. There are lot of herbs which are used as MPs for the ailments various diseases in different seasons. So, there is a need to promote the use of MPs to save the human lives. The PEs of various plants are also used against the plants diseases and are comparatively safe to the human lives than the CBFs. Today, these natural products are the signs of safety as compared to the synthetic drugs and fungicides. These MPs and PEs are regarded as safe to human being as well as environment. Although the synthetic products of modern era have suppressed the importance of natural products but now it is the desired need time to promote them globally in case of both human pathology as well as plant pathology.

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