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Endangered Medicinal Species in Kerala

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ABSTRACT

Nature has bestowed India with an enormous wealth of medicinal plants, due to which our country is often referred as the 'Medicinal Garden' or 'Botanical Garden' of the world (Ahmadullah and Nayar 1999). Of 48,655 plant species documented (including virus, bacteria, algae, fungi and lichens) 9,500 species have ethnobotanical importance and 7,500 species are in medicinal use for indigenous health practices as well as modern systems of medicines (Kumar et al. 2013; Sharma and Pandey 2013). Plants produce an extensive array of secondary metabolites that can be used as ingredients for pharmaceuticals, flavors, agrochemicals, fragrances, colors, biopesticides, and food additives. Some of the useful substances/chemicals found in plants include alkaloids, carbon compounds, essential oils, resins, nitrogen, glycosides, hydrogen, tannins, and gums. And, most of these substances isolated from plants possess medicinal properties. They are used as a precursor for the synthesis of useful medicines/drugs. There is a rapid increase in the use of medicinal plants worldwide due to the increasing demand for herbal drugs, natural health products, and secondary metabolites of medicinal plants. In recent years, medicinal plants have also been gaining immense popularity not only in developing countries but also in developed countries due to various side effects of synthetic drugs. Therefore, the demand for the basic raw material has been further increased and forest areas are hardly able to meet this increasing demand of industries. The rich source is disappearing at an alarming rate as a result of over-exploitation. Consequently, many of the important plant species have been threatened and some of them on the verge of extinction due to unscientific collection by untrained persons. Therefore, the management of traditional medicinal plant resources has become a matter of urgency. In view of these reasons, there is an urgent need to conserve and to propagate some important medicinal plant species so as to save them from extinction and also to ensure greater availability of raw material. This article presents an overview of the situation of medicinal plant availability in Kerala and approaches to save these plants and use them with a sustainable approach.

INTRODUCTION

Human beings have been using plants as medicine for as long as we have existed on Earth. The interest in biodynamic phytotherapy has increased many folds all over the world because of its impressive record of safety and efficacy for many common diseases and several chronic ailments. Approximately 80% of the people in the world's developing countries rely on traditional medicine for their primary health care, and about 85% of traditional medicine involves the use of plant extracts (Vieria and Skorupa, 1993). The goal of 'Health for All' by WHO cannot be achieved without herbal medicines. This increased use of medicinal plants has unfortunately led to heavy pressure on the native populations of these plants when they are collected from the wild. In some cases, the overharvesting of particular herbs has even led to their extinction. Awareness of this problem is very important to prevent their extinction.

In India, more than 90% of medicinal plants are facing threat due to excessive and unsustainable collection, utilization, overexploitation or un-skilled harvesting (Kumari et al. 2011). Based on global rates of plant species threatened with extinction, it is estimated that around 1,000 medicinal plant species may be under threat in different eco-systems across India. As per the IUCN Red List, a total of 457 species out of 2,143 species are listed under medicine for human and veterinary groups. Of these, 73 are threatened (CR, EN, VU), 8 (NT), 1 (DD) and 366 (LC). The distribution of medicinal plants is not uniform worldwide. China and India have the maximum diversity of medicinal plants followed by Colombia, South Africa, and the United States. And, the risk of extinction of these medicinal plants is mostly supposed to be in countries like China, India, Kenya, Uganda, Tanzania, and Nepal. The rich source is disappearing at an alarming rate as a result of over-exploitation. Therefore, the management of traditional medicinal plant resources has become a matter of urgency.

AIMS AND OBJECTIVES

The present study has been undertaken with the following aims and objectives.

1. To study about the Endangered medicinal species in Kerala.

2. Collection of various vegetative propagation practices for improving the existing population.

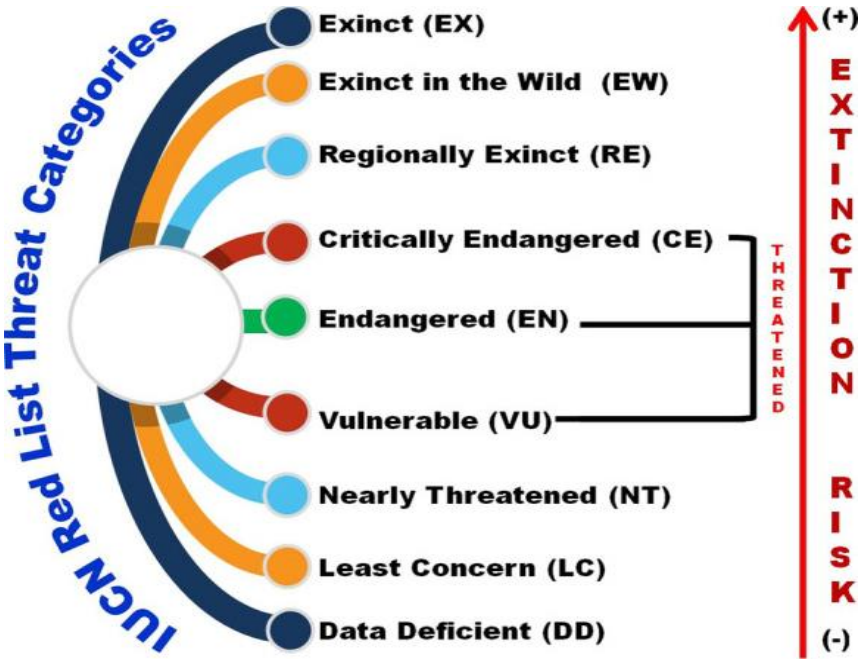
MATERIALS AND METHODS

The collection of data about endangered medicinal species in Kerala from a systematic approach to a wide variety of books, journals and previous research works on the topic of Endangered and Threatened species of plants as well as related conservation efforts. Computerized searches of published and unpublished works related to the study were also referred.

RESULT AND DISCUSSION

The World Health Organization (WHO) has estimated that the present demand for medicinal plants is approximately US $14 billion per year. The demand for medicinal plant-based raw materials is growing at the rate of 15 to 25% annually, and according to an estimate of WHO, the demand for medicinal plants is likely to increase more than US $5 trillion in 2050[1]. In India, the medicinal plant-related trade is estimated to be approximately US $1 billion per year (Kala et al., 2006). According to Schippmann et al. (1990), one-fifth of all the plants found in India are used for medicinal purpose. The world average stands at 12.5% while India has 20% plant species of medicinal value and which are in use. But according to Hamilton (2003), India has about 44% of flora, which is used medicinally. Although it is difficult to estimate the total number of medicinal plants present worldwide, the fact remains true that India with rich biodiversity ranks first in per cent flora, which contain active medicinal ingredients (Mandal, 1999).

A total of 560 plant species of India have been included in the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened species, out of which 247 species are in the threatened category[1]. On a global basis, the IUCN has estimated that about 12.5% of the world's vascular plants, totaling about 34,000 species are under varying degrees of threat (Phartyal et al., 2002). IUCN recognizes the following categories: extinct, extinct in the wild, critically endangered, endangered, vulnerable, near threatened, least concern, data deficient and not evaluated. Species with small populations that are not at present endangered or vulnerable but are at risk are called rare. (Singh et al., 2006). Many of them are facing extinction.



IUCN Red List threat categories and their risk level

List of some endangered and economically important medicinal plants of India[1]

SI No	Plant Species	Family	References
1	Aegle marmelos	Rutaceae	Yadav and Singh (2011a)
2	Acorus calamus	Aracea	Yadav et al. (2011)
3	Celastrus paniculatus	Celastraceae	Lal & Singh (2010) Lal et al (2010)
4	Commiphora Mukul	Burseraceae	Singh et al. (2010b)
5	Peganum harmala	Nitrariaceae	Goel et al., (2009)
6	Prosopis cineraria	Fabaceae	Kumar & Singh (2009)
7	Simmondsia Chinensis	Simmondsiaceae	Kumar et al. (2010)
8	Spilanthes acmella	Asteraceae	Yadav and Singh (2010) Yadav and Singh (2011b)
9	Stevia rebaudiana	Asteraceae	Kumar & Singh (2009) Singh et al. (2011)
10	Sapindus mukorossi	Sapindaceae	Singh et al. (2010a)
11	Bacopa monnieri	Scrophulariaceae	Mohapatra and Rath (2005)
12	Ginkgo biloba	Ginkgoaceae	Tommasi & Scaramuzzi (2004)
13	Glycyrrhiza glabra	Papilionaceae	Vadodaria et al., (2007)
14	Gymnema Sylvestre	Asclepiadadeae	Komalavalli & Rao (2000)
15	Holostemma ada-kodien	Asclepiadadeae	Martin (2002)
16	Oroxylum indicum	Bignoniaceae	Dalal & Rai (2004)
17	Picrorhiza kurroa	Scrophulariaceae	Martin et al (2006)
18	Saussurea lappa	Compositae	Johnson et al. (2007)
19	Swertia chirata	Gentinaceae	Balaraju et al. (2009)
20	Tinospora cordifolia	Menispermaceae	Gururaj et al. (2007)

Medicinal plant species of conservation concern identified for Kerala[2]

Critically Endangered	*Eulophia cullenii, Valeriana leschenaultii, Coscinium fenestratum, Heliotropium keralense, Janakia arayalpathra, Paphiopedilum druryi, Piper barberi, Utleria salicifolia, Vateria macrocarpai*
Endangered	*Holostemma ada-kodien, Rauvolfia serpentina, Oroxylum indicum, Acorus calamus, Ampelocissus indica, Cayratia pedata, Cinnamomum wightii, Decalepis hamiltoni, Dipterocarpus indicus, Dysoxylum malabaricum, Garcinia travancorica, Gymnema khandalense, Gymnema montanum, Humboidtia vahiana. Hydnocarpus macrocarpa, Merremia turpethum, Nilgirianthus catus, Operculina turpethum, Plectranthus nigherricus, Santalum album, Semecarpus travancorica, Strychnos aenea, Swertia lawii, Syzygium travancoricum, Trichopus zeylanicus*
Vulnerable	*Adenia hondala, Amorphophallus commutatus, Ampelocissus araneosa, Aphanamixis polystachya, Artocarpus hirsutus, Baliospermum montanum, Calophyllum apotalum, Canarium strictum, Celastrus paniculatus, Chonemorpha fragrans, Cinnamomum macrocarpum, Cinnamomum sulphuratum, Curcuma pseudomontana, Cycas circinalis, Diospyros candolleana, Diospyros paniculata, Drosera peltata, Embelia tsjeriam-cottam, Garcinia indica, Gardenia gummifera, Gloriosa superba, Glycosmis macrocarpa, Helminthostachys zeylanicus, Heracleum candolleanum, Hydnocarpus alpinia, Hydnocarpus pentandra, Kingiodendron pinnatum, Michelia nilagirica, Myristica dactyloides, Myristica malabarica, Nervalia aragoana, Nothapodytes nimmoniana, Ochreinauclea missionis, Persea macrantha, Pseudarthria viscid, Pueraria tuberosa, Salacia oblonga, Smilax zeylanica, Swertia corymbosa, Tragia bicolor, Vateria indica.*

Some strategies to conserve medicinal plants include Ex-situ conservation and in-situ conservation.

- Ex-situ conservation: In this process, endangered species are protected outside their natural habitat. Examples include botanical gardens and seed banks.

- In-situ conservation: It's protecting the endangered species in their natural habitat by the conservation of their ecosystem and natural habitats. Its examples are natural reserves and wild nurseries.

Apart from ex-situ and in-situ conservation, good agricultural practices (GAP) are another approach to conserve plant species. For improved yields and quality of target products, these practices provide the appropriate levels of water, nutrients, optional additives, and environmental factors including temperature, light, and humidity.

To serve this objective, the International Union for Conservation of Nature (IUCN), a membership union composed of both government and civil society organizations, was established. Although species conservation is achieved most effectively through the management of wild populations and natural habitats (in situ conservation) but most of the medicinal plants either do not produce seeds or seeds are too small and do not germinate in soils. Even plants raised through seeds are highly heterozygous and show great variations in growth, habit, and yield and may have to be discarded because of poor quality of products for their commercial release. Likewise, majority of the plants are not amenable to vegetative propagation through cutting and grafting, thus limiting the multiplication of desired cultivars. Moreover, many plants propagated by vegetative means contain systemic bacteria, fungi and viruses which may affect the quality and appearance of selected items (Murch et al., 2000). Thus mass multiplication of disease-free planting material becomes a general problem. In order to overcome these barriers, ex situ techniques can be used to complement in situ methods and, in some instances, may be the only option for some species (Sarasan et al., 2006; Negash et al., 2001). Therefore, conservation of medicinal plants can be accomplished by the ex situ, that is, outside natural habitat by cultivating and maintaining plants through long-term preservation of plant propagules in plant tissue culture repositories (Rands et al., 2010). In vitro techniques have been increasingly applied for mass propagation and conservation of germplasm as it has superiority over conventional method of propagation and offer some distinct advantages over alternative strategies.

Some of these are as follows:

- Collection may occur at any time independent of the flowering period for each species (this assumes that seed material is not required).
- There is the potential of virus elimination from contaminated tissue through meristem culture.
- Clonal material can be produced where which is useful for the maintenance of elite genotypes.
- Rapid multiplication may occur at any time when stocks are required using micropropagation procedures.
- Germination of difficult or immature seeds or embryo may be facilitated for breeding programmes.
- Distribution across the border may be safer, in terms of germplasm health status using in vitro cultures.

Some more general positive advantages of in vitro techniques include the fact that storage space requirements are vastly reduced compared with field storage. Storage facilities may be established at any geographical location and cultures are not subject to environmental disturbances such as temperature fluctuation, cyclones, insects, pests, and pathogen (Bhojwani and Dennis, 1999; Shibli et al., 2006). In this regard, the micro-propagation holds significant promise for true to type, rapid and mass multiplication under disease free conditions. Besides, the callus derived plants exhibit huge genetic variation that could be exploited for developing superior clones/varieties particularly in vegetatively propagated plant species.

Tissue culture has emerged as a promising technique for multiplying and conserving the medicinally important species within short periods and limited space, which are difficult to regenerate by conventional methods and save them from extinction. In recent years, in-vitro cell and tissue culture methodology is envisaged as a mean for germplasm conservation to ensure the survival of endangered plant species, rapid mass propagation for large-scale re-vegetation and for genetic manipulation studies under precisely controlled physical and chemical conditions. Combinations of in vitro propagation techniques (Fay, 1992) and

cryopreservation may help in the conservation of biodiversity of locally used medicinal plants (Singh et al., 2006).

The Government of India has developed a few regulatory frameworks and policies viz.,

- Indian Forest Act, 1927;
- Panchayat Raj Act, 1933;
- The West Bengal Forest Produce Transit Rules, 1955;
- Andaman and Nicobar Island Forest Produce Transit Rules, 1966;
- Wildlife (Protection) Act, 1972 (Amended 2003) Also 2006;
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1975;
- Kerala Forest Produce Transit Rules, 1975;
- The Forest (Conservation) Act (Amended), 1980;
- Environment Protection Act, 1986;
- National Forest Policy, 1988;
- Negative list of Plants for Exports and Imports (Revised), 1994;
- Panchayat (Extension to Scheduled Areas) (PESA) Act, 1996;
- National Biodiversity Strategy and Action Plan, 2002;
- The Biological Diversity Act, 2002;
- Biological Diversity Rules, 2004;
- Negative list of MAP Collection from Wild, 2004;
- Scheduled Tribes and Other Traditional Forest Dwellers Act (FRA), 2006;
- Maharashtra Forests Rules, 2014, The HP Forest Produce Transit (Land Route) Rules, 2013;
- Export Import Policy, 2015–20;
- National Wildlife Action Plan 2017–31;[2]

CONCLUSION AND RECOMMENDATION

Habitat loss and unchecked commercialization of wild medicinal plants are threatening the future of vital resources, as well as the beauty, diversity, and natural heritage of our planet. As wildlands are destroyed or degraded, we lose unique and precious species, from flowers to frogs to butterflies, and with them potential resources to combat hunger, poverty, natural disasters, and social and economic insecurity. This loss of diversity may also take with it important cures for diseases both those we face now and those that may emerge in the future. Unchecked commercialization may render important traditionally used medicinal plant resources inaccessible and unaffordable to populations that have relied on them for centuries as well as to the rest of the world. At current extinction rates experts estimate that the Earth is losing at least one potential major drug every 2 years[3]. There is a need of hour to conserve these threatened species by bridging the gap.

Out of 18,665 plants, the classic systems of medicines make use of only about 3000 plants in various formulations (Schippmann et al., 2006). Multiple exotic plants are existent in India which are not referred to either in classical literature of Ayurveda that is Samhitas or in Nighantus and are commonly referred to as Anukta Dravya in Ayurveda. Incorporation of these exotic plants in therapeutics would fill the gap in Ayurvedic Pharmacopoeia where the classical drugs are facing the problems of scarcity.

To review trade regulations and their implementation, develop its cultivation packages, sustainable collection practices, and habitat management, besides conducting surveys and periodic monitoring across known range may prove beneficial. Compared to other crops, medicinal crops cultivation requires less attention and expenditure and can be successfully adopted by the cultivators. By doing so, we will not only able to conserve the precious wealth of medicinal plants but also we will achieve the goal of conserving the rare and endangered species, which are threatened, and at the verge of extinction. In this regard, CIMAP and ICAR institute play an important role in conserving rare and endangered medicinal species and developing agricultural technologies and market linkages to farmers in order to extend the area and generate income to the farmer[4].

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