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Competitive Biodiversity of Human and Vascular Plant Species: The Implications for Pharmaceutical Industries, Health and World Economy Part- 1

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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Review Article

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ABSTRACT

Aims: This work is a survey of the distribution of vascular plant species that have medicinal values.
Methodology: The census, medicinal uses, economic benefits and existence threats of the plants were reassessed.
Results: Additional members of *Asteraceae* have been discovered from 12,000 to 20,000 species with *Centaurea* species (500) mostly used in the family. Stevia produces steviol glycoside that is 200–300 sweeter than sugar with market value of 2-3 billion yen/year. Species of *Orchidaceae* (20,000) have been discovered with 3,000 and 2,500 endemic to Columbia and Ecuador respectively. Other members of family that have been increasingly discovered are *Fabaceae* (8,000), *Euphorbiaceae* (7,300) with Euphorbia species (1,600), *Rosaceae* (3,000), *Boraginaceae* (2,000), *Polygonaceae* (1,200) whereas Acacia (1,380) and Salvia (900) species have also been discovered.
Conclusion: The increased number of species may be due to additional discovery, genetic polymorphism and evolution. However, threats to their existence may be due to urbanization, deforestation, over exploitation, environmental pollution and fires. Therefore, management

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strategies aimed at conserving medicinal plants biodiversity are very important for development of raw materials for pharmaceutical industries and synthesis of drugs for treatment of human and animal diseases that can contribute to world economy. Despite more plants with medicinal values have been discovered their over use could threaten their existence. Hence, North America, Argentina, China and Australia have started embarking on genetic propagation of their threatened plants.

Keywords: Biodiversity; medicinal plants; extinction; economy; pharmaceutical industry.

1. INTRODUCTION

Biodiversity is defined as different life forms on earth, the genetic variation between them and their complexed ecological interrelations. Therefore, it embraces the differences between a dandelion and a dodo (species diversity), between green and red apples (different varieties), between eskimos and aborigines (cultural diversity) and between alpine meadows and coral reefs, ecosystem diversity [1]. Most of the world's biological diversity is located in countries of the south. The north and its private industry is increasingly using these countries as reservoir of biological and genetic resources to develop new products such as crop varieties, drugs, biopesticides, oils and cosmetics. Therefore, biodiversity has become the raw material of the new biotechnologies and the object of patent claims [2].

Medicinal plant is the plant claimed, used or proven to have therapeutic value in the treatment of infectious and non-infectious diseases in human or animal. The nutraceutical uses of Plants had been evidenced not only by the fact that the Demon lured Adam into eating from forbidden tree but also, by the fact that Archangel Michael used Euphrasia to clear Adam's vision while in the Garden of Eden. Green reported that excavations of cave dwellings occupied over 300,000 years ago revealed that pecking man, the extinct species closest in resemblance to modern man (*Homo sapiens*) gathered wall nuts, hazel nuts, pine nuts and rosehips. These findings did not indicate that man could eat plants as food but rather people's ability to manipulate plants became increasingly sophisticated with time and exposure [3]. Recent archaeological findings revealed that at least 3000 plant taxa have been used as food by man and 200 out of these have successfully been domesticated [4].

2. HISTORY OF VASCULAR MEDICINAL PLANTS ESTIMATION

The study of plant medicines was first described precisely in the basic literature Charak Samhita of Ayurvedic medicine in India, the man who flourished in the 8th century. In the 16th century, a fundamental turning point reached the history of medicinal plants with the advent of the Swiss-German physician Paracelsus (1439-1541) who gave the concept of what is now defined as active principles of plants [5]. Presently, about 80% of marginal communities all over the world use medicinal plants for treatment of central nervous system (CNS) diseases, tumor, diabetes, blood pressure and as adaptogenic [6]. Govaert reported that 12.5% of 422,000 of the world flowering plants are used medicinally [7] and 8% are threatened [8]. But Bramwell reported that 17.1% of 422,000 flowering plants are used medicinally while 21% are threatened [9]. All these mark the beginning of third millennium AD, which has not only witnessed a preponderance of enthusiastic researchers in the field of phytomedicine, but also experienced a resurgence in the interest and use of phytomedicine all over the world, perhaps because of high cost, adverse effects and treatment failure of orthodox medicines coupled with the fact that more than 3.5 billion people rely on plants for the treatment of both human and livestock diseases [10]. For instance, it is estimated that almost half of all health care consumers in the United States take some form of herbal or natural product supplements alone or in combination with conventional medicine [11]. Herbology which began when the first primitive cave man ate the first primitive dandelion to relieve her of menstruation pain 50,000 years ago [12] has been increasingly accepted. For example, the use of medicinal plants by North Americans has increased from 3% in 1991 to 37% in 1998 given the total sales of about $3 billion USD per year [13]. But two thirds of 50,000 medicinal plants in use are still harvested from the wild and between 4,000 and 10,000 of them may now be endangered [14]. Therefore, there is growing concern about diminishing populations, loss of genetic diversity, local extinctions and habitat degradation. The renewed interest in the use of traditional medicine in the past few years coupled with advocacy of World Health Organization (WHO)

for the proper identification, sustainable exploitation, scientific development and appropriate utilization of herbal medicines which provide safe and effective remedies for medical care [15] have necessitated the need for census of higher plants, with a view to estimating the number of medicinal plants in various countries of the world. Since medicinal plants are increasingly being discovered, the number of plants with medicinal values may be either under estimated or over estimated. Hence, the aims of this survey are to estimating number of vascular medicinal plants and their contributions to pharmaceutical industries, health and world economy.

3. BIODIVERSITY OF MEDICINAL PLANTS

Orchid family (Orchidaceae) is the second largest family of flowering plants with approximately 20,000 species with more than 850 genera. This diversity increases towards the tropic; where the epiphytic species predominate, that almost constitute 73% of the family. Columbia is the country with greatest number of orchid species (3,000 species) followed by Ecuador and Brazil (2,500 species each). The only economically important product in this family is Vanilla native to Mexico and Tropical America. It worth 100 million US dollar. The Aztecs originally used Vanilla as a flavouring for chocolate, and the Spanish conquerors carried it back to Europe where it was used for the same purpose [16]. The genus Annona originated from Central America with nutraceutical values [17]. *Casimiwa pringlei* has been used in Mexico since prehistoric times [18]. The genus *Casimiwa* is native to Mexico and Central America [19]. *Euphorbiaceae* comprising about 2,000-7,300 known species and ranging from annual to perennial trees. Over 82 species of Euphorbia have been found in Iran [20]. Some species are used in the treatment of skin diseases, gonorrhoea, intestinal parasites, inflammation and warts [21]. *Sambucus edulus* (Dwarf elder) belongs to *Adoxaceae* family in the order of the *Dipsacales* that contains about 190 species and 4 genera mainly distributed across Southern and Central Europe, North west Africa and South East Asia (especially northern Iran). Two of the most familiar members of *Dipsacales*, *Sambucus* and *Vibumum* formerly in *Caprifoliaceae* have been moved into *Adoxdeae* along with some other genera. The main species are *S. edulis, S. nigra, S. racemosa*, *S. africana* and *S. palmensis* [22]. *Barenwort*, is a perennial plant of the genus *Epimedium (Berberidaceae)* used to improve menopausal symptoms, bone health [23], osteoporosis, rheumatism, hypertension and coronarary heart diseases [24]. More than 60 species are known, out of this, 50 species are found in China. *Hypericum perforatum* (St. John's wort) is a perennial weed found in Europe, Asia and North Africa, four species have been recognized. The species include *H. perforatum, L. vulgare*, *H. latifolium*, *H. veronese* and *H. angustifolium*. The genus *hypericum* contains about 400 species divided into 30 subgroups that are spread throughout temperate and tropical areas of the world [25]. *H. perforatum* is an example of *hypericaceae* used for the management of mild and moderate depression [26]. Genus *Tanacetum* includes about 50 species of those only *Tanacetum santolinoides* (D.C) which grows in Egypt has been adequately recognized. Salvia species (Sage family) before comprised 500 species of plants e.g. *Salvia repens* found in South Africa. From 900 species of Salvia which are presently distributed in the world, about 17 species are endemic in Iran. Salvia, the largest genus of the *Lamiaceae* family is economically important, since Salvia species have been used as spices and flavouring agents in perfumery and cosmetics [27]. The genus Salvia, produces many useful secondary metabolites including terpenes and phenolics and their derivatives that have been in the centre of pharmacopoeias of many countries [28]. It is used for the treatment of sore, diarrhoea, stomachache. Turkey is an important gene-centre of the family *Lamiaceae* (*Labiatae*) having 45 genera, 546 species and 730 taxa. The rate of endemism is 44.2% [29]. Nepeta species (*Lamiaceae*) – comprises 250 species of plants seen in Central and Southern Europe, Asia, the Middle East, Northern Africa and Tropical mountains in Africa [30]. It is used as diuretic, diaphoretic, vulnerary, antitussive, antispasmodic, antiasthmatic, tonic, febrifuge, emmenagogue and Carminative. Morus species e.g. *Morus rotunbiloba Koidz* is widely cultivated in Thailand and many Asian countries. Other species are *M. alba, M. indica*, and *M. mongolica* have uses in treatment of various diseases. Chickpea (*Cicer arietinum L*.) is the third most important food legume grown in 11.8 million ha with 8.8 million ton productions in 2008. It is grown in 45 countries in all continents of the world [31]. For at least 2000 years *Panax ginseng* has been valued as a medicinal plant in traditional oriental medicine. *Boesenbergia* belongs to a higher family *Zingiberaceae* in the order of *Zingiberales*. *Boesenbergia* is a genus of

about 80 *Boesenbergia* species distributed from India to South East Asia. The genus prosopis comprises almost 50 species, 25 of which are on the list of federal noxious weeds. They are most often spiny trees or shrubs predominantly well adapted to hot acid climates [32]. The genus *Amberboa* has 58 reported compounds. *Compositae* (*Asteraceae*) is a vast family of flowering plants, distributed in all parts of the world. It comprised 800 genera before but has increased to 900 genera and nearly 20,000 species. These are most annuals or periannual herbs, a few are woody but not usually true trees. Many of these genera are grouped among ornamentals [33]. The genus Origanum consists of 38 species of annual, perennial and shrubby herbs; most of which are native or restricted to the Eastern part of the Mediterranean area particularly in Italy, Greece and Turkey. There are 24 species, and 27 taxa available in the flora of Turkey and the East Aegean Islands, 16 of them are endemic. The genus Origanum is common in the hilly locations of mediterranean region and Turkey is considered the genetic centre of the Origanum, because the genus is represented by 32 species, 21 being endemic. The most familiar species are *Origanum onites*, *O. minutifilorum, O. majorana, O. syriacum var. oevanii,* and *O. vulgare varhirtum*. The genus Colchicum belongs to the family *Liliaceae* and includes 100 species worldwide [34] and represented by 46 species in Turkey. *Moraceae* family constitutes large taxa of over 50 genera and nearly 1,400 species including, Atorcarpus, Morus and Ficus [35]. Nearly 2,000 cultivars of date palm (*Phoenix dactylifera*) are known in the world. The world production of dates has increased extensively during the last 30 years from 1,915,615 tonnes in 1975 to 6,002,040 tonnes in 2005 [36].

Family *Boraginaceae* including about 100 genera and 2,000 species in all over the world and divided into four subfamilies: Boraginoideae, Heliotropioideae, Cordioideae and Ehretioodeae. In China, the family *Boraginaceae* is represented by more than 200 species belonging to 49 genera and about 30 species belonging to 17 genera have medicinal therapeutics [37]. The main medicinal plants of *Boraginaceae* family are distributed namely in the following genera; Cynoglossum, Lappula, Lithuspermum and Onosma of the subfamily Boraginoideae [38]. *Polygonaceae* Juss, the Buckwheat, Smart Wheat or knotweed family are a group of *dicotyledons* containing approximately 1,200 species in 48 genera [39]. The family is represented in Pakistan by 19 genera and 211 species. Persicaria is a variable genus of Plygonaceae containing approximately 120 species, generally weeds occupying disturbed areas and crop fields [37]. It is distributed in northern and southern hemisphere and in Pakistan represented by 103 species [40].

The genus Kobressia wild belongs to the tribe Cariceae in the family Cyperaceae. This genus has about 70 species all over the world of which 59 are found in China [41]. *Kalopanax pictus* (Prickly castol oil tree) is a deciduous tree of Araliaceae family that contains 900 species and 50 genera in the world and it is mainly distributed across East Asia. The Salconioideae subfamily comprises approximately 15 genera and 50 species. The Salconia species are in Korea and distributed in tidelands on Western Coast of Korea. Canellaceae comprises of 9 plants species that have unsaturated dialdehydes with a drimane skeleton. Example of the species in this family is *Warburgia ugandensis*. The *Asteraceae* family is the largest and the most cosmopolitan of the flowering plants and is probably the most widespread in the mediterranean. The genus Helichrysum belongs to the *Asteraceae* family and consists of an estimated 600 species. The name is derived from the Greek words Helisso (to turn round) and Chrysos (gold). Common name includes “straw flower”. It occurs in Africa (with 244 species in South Africa), Madagascar, Australia, Asia and Eurasia. *Moringa oleifera* is the most widely cultivated species of the monogeneric family Moringaceae (Order Brassicales) which includes 13 species of tree and shrubs distributed in sub-Himalayan ranges of India, Sri Lanka, North- eastern and South-western Africa, Madagascar and Saudi Arabia [42]. *Cosmos caudatus* belongs to the family *Asteraceae*. It is an edible plant having 20-26 species worldwide popularly known in Malaysia as Ulam Raja (King’s Salad). Genus Achillea belonging to family *Asteraceae* found in Iran having 19 species [43]. Engler divides the *dicotyledons* into two groups; *Archichlamydeae* and *Sympetalae*. The *Archichlamydeae* are further divided into 37 orders and about 226 families and the sympetale into 11 orders and about 63 families. Centaurea, a genus of about 500 species of herbaceous plants of the *Compositae* (*Asteraceae*) family and native to the Mediterranean region is widely used in Middle Eastern folk medicine. *Centaurea thessala* ssp*. drakinensis, C. ainetensis, C. attica, C. musimonum, C. diffusa, C. cyanus, C. scabiosa, C. calcitrapa, C. solstialis,*

C. melitensis, C. iberica, C. jacea and *C. aspera* all have medicinal properties. *Phlomis* is a genus of the family Lamiaceae (Labiatae) consisting of 100 species of herbs and shrubs, many of which are highly variable used as tonics and stimulants. Examples of medicinal Phlomis species are *P. bracteosa* and *P. cashmarina* [44]. Stevia rebaudiana discovered by Bartoni in 1905 belonging to *compositae* family is native to Paraguay and Brazil [45]. Its fresh leaf and stevioside are 30 – 45 times and 200 – 300 times respectively sweeter than sugar [46]. *Stevia rebaudiana* is one of 154 members of the genus Stevia, which produces sweet steviol glycoside. The first report of its commercial cultivation was in Paraguay in 1964 [46]. Stevioside concentrations range from 3 – 10% of leaf dry weight, rebaudioside A. (400 times sweeter than sugar) is less concentrated (1 – 3%) [40]. Stevia is a natural non-calorie sweetener [41] indigenous to northern regions of South America and was first established in Japan in 1968. The total market value of stevia sweetener in Japan is 2-3 billion yen/year. It is presently cultivated in China, Taiwan, Thailand, Korea, Brazil, Malaysia, Israel, Ukraine, United Kingdom, Canada, Philipines, Hawaii and California. The leaves of Stevia contain diterpene glucosides namely stevioside and rebaudioside which are not metabolized [42]. Olive trees are distinct from most other horticultural species since they are much long lived trees as compared to many others. There are many olive trees reported to be more than 1000 years old from different parts of Mediterranean Basin [43]. *Eruca sativa* L., commonly known as rocket plant belongs to Brassica family, contains more than 350 genera [43]. Approximately 400 plants that accumulate high content of metals have been reported in recent years and these belong to the families, Brassicaceae, Euphorbiaceae, *Asteraceae*, Lamiaceae and Scrophulariaceae. The largest group of these plant called metal hyperaccumulators are found in the genus Alyssum (Brassicaceae), in which Nickel concentrations can reach up to 3% of dry leaf biomass. The genus Ocimum, a member of the Lamiceae family, contains 200 species of herbs and shrubs. This species is used as culinary and flavour to many foods in addition to its insecticidal and nematicidal properties [45]. The genus Ocimum is considered as one of the largest genera of the lamiaceae family. *O. basilicum* (Sweet basil) is an annual herb which grows in several regions all over the world [46]. Hoya is a genus of 300 species of tropical climbing plants, native to South Asia (India and China), Australia and Polynesia. Hoya, commonly known as wax plant because of its waxy appearance is of significant horticultural importance in Europe, America and Australia. *H. wightii* ssp*. palniensis* is restricted to Western Ghats of Tamil Nadu, India. *Hylocereus polyrhizus*, which originated from Latin America, is a member in the *Cactaceae* family [47]. Members of the Cactaceae family are mainly appreciated for their ornamental qualities, but there are at least 250 cultivated species [48]. The genus, *Berberis* belonging to the family *Berberidaceae* consists of spiny shrubs widely distributed in temperate and subtropical regions of Northern hemisphere and temperate South-America. Berberis has about 650 species worldwide [49] of which 54 have been from Indian Himalaya [50]. Acacia is the most significant genus of the family leguminosae, first described by Linnaeus in 1773. It is estimated that there are roughly 1380 species of Acacia worldwide, about two-third of them native to Australia and the remaining one third native to the rest part of the world. More than 40 species of Acacia has been listed in the book titled Flora of Madras Presidency. It is used for the treatment of skin diseases, sexual, stomach and toothache problems [51]. *Euphorbiaceae* are wide spread in nature ranging from herbs and shrubs to trees in tropical and temperate regions of the world. The family *Euphorbiaceae* comprises of 280 genera with the largest genus Euphorbia having about 1600 species with characteristics milky latex sticky sap, co-carcinogenic, severe skin irritation and toxic to livestock and humans [51].

Melaleuca bracteata T. mudl belongs to the family Myrtaceae, which contains over 250 plant species. The so-called tea tree or Johannesburg gold has ornamental and medicinal properties. It is used for the treatment of human immunodeficiency virus infection. The genus Citrus belonging to the family Rutaceae comprises about 40 species which are distributed in India, China, Malaysia, Srilanka and Australia [52]. Romania has 21 wild and 3 cultivated Allium species [53]. Out of 1000 species of *Piper (P.)*, *P. nigrum* is the most important cultivated species due to its economic value [54]. Acinos Miller is one of the smaller genera of the lamiaceae family native to Europe, Mediterranean, Central Asia, Northern Africa and North America. The name Acinos comes from the Greek word akinos meaning aromatic plant. Genus Acinos Miller comprises 11 species [55]. *Leguminosae* is the third largest family within flowering plants and is constituted of 650 genera

that include about 18,000 species [56]. The family is represented with 69 genera and 974 species in Turkey [57] and is divided into 3 sub families, namely, Mimosoideae, Caesalpiniodeae and Papilionoideae. Acacia is the most significant genus of the family Leguminosae, first described by Linnaeus in 1773. It is estimated that there are roughly 1,380 species of Acacia worldwide, about two-third of them native to Australia and the remaining one third native to the rest part of the world. More than 40 species of Acacia has been listed in the book titled Flora of Madras Presidency. It is used for the treatment of skin diseases, sexual, stomach and toothache problems [51]. The genus Gemsta is represented with 13 species in Anatolia. Examples of endemic species are *Gemsta burdurensis, G. gibbs, G. involucrate Spach, G. aucheri Boise, G. sandrasica Hartwig* and *Strid, G. vuralii A.* [58]. *Rosaceae*is a family of about 100 genera and 3,000 species, comprising 200 prunus among other species. Out of the 308 ancestral varieties, 38 provided approximately 54.18 and 56.84% of nucleous and cytoplasmic genetic material. It is estimated that *Prunus africana* alone has a current market value of around $150 million per annum [59]. Members of *Rosaceae* occur in a variety of habitats throughout the world, but the family is best developed in the northern hemisphere where it is also of tremendous economic importance. The vast majority of fruits of the North temperate regions including species of Malus Mill (Apples), *Pyrus* L. (Pears), *Fragaria* L. (Strawberries), *Rubus* L. (Rasp berries and Black berries) and *Prunus* L. (Peachea, plums, Cherries, Apricots and Almonds) are all members of Rosaceae. The family also includes many ornamentals, cultivated primarily for their beautiful flowers, such as species of *Rosa* L (Roses), *Potentila* L. (Chinquefoil), Sorbus L. (Mountain ash) and *Spiraea* L. (Bridal wreath). Bananas and Plantains are perennial herbaceous monocots which belong to the Musa genus of Musaceae family. They are cultivated in the tropical and sub-tropical areas all over the world, with a yearly production of about 70 million tonnes. They are ranked as the fourth important fruit crops which provide diet to millions of people, especially in South East Asia [60]. *Micheliachampaca L*. known as Champaca belongs to the family of Magnoliaceae. It consists of 12 genera and 220 species of ever green trees and shrubs, native to tropical and sub-tropical South and South east Asia (Indomalaya) including South China. There are three species of Michelia available in Malaysia. They are *Michelia alba* (White Chempaka), *Michelia champaca* (Orange Chempaka) and *Michelia figo* (Dwarf Chempaka) with *M. champaca* and *M. alba* being the most popular species within the family [61]. There are about 40 species of wild sun flower (Girasole articiocco) within the borders of USA. The genus Abies from the family Pinaceae consists of 51 species mainly found in temperate and boreal regions of the northern hemisphere, chiefly in the mountainous regions. The literature data on phytochemical and biological activities of the genus Abies revealed that 277 phytochemicals were isolated from 19 Abies species. *Abies pindrow* is an example seen throughout the western Himalaya from Afghanistan to Nepal [62]. Cucurbita spp. is collectively ranked among the 10 leading vegetables worldwide. China and India are the world leading producers. Date palm (*Phoenix dactylifera L*.) is one of the earliest cultivated tree crop [63] with long generation time of 4-5 years to start flowering and continues producing fruit with an average age yield of 400-600 kg/tree/year up to 60 years of age [64]. About 600 species of Oak trees make up the genus Quercus of the family Fagaceae. Oak varies from small bushes to great trees found in North Temperate Zone growing in varieties of habitats such as seacoast, mountain slopes and wet lowlands. It has anti-inflammatory, astrigent [65], antiviral [66], antidiabetic and gastro proctective activities [67]. The most species rich medicinal plants families include Fabaceae, *Asteraceae* and Lamiaceae [68]. More than 300 species of Stachys has been reported. In Iran this genus is represented by 34 species including *Stachysathorecalyx*, a widely distributed species of Iran. It is used for the treatment of infections, arthritis, respiratory and inflammatory disorders. The genus Magnolia consists of about 120-130 species. The majority of Magnolia species grow in the temperate and tropical zones of South Eastern Asia [69]. Thymus (Lamiaceae) is distributed in Eurasian and the Mediterranean region. Genus Persicaria mill of the family *Polygonaceae* comprises approximately 120 species, mainly concentrated in north temperate regions of hemispheres. Its members are largely weeds, mostly found in disturbed areas and crop fields. The genus Artemisia from Asteraceae family includes variable number of species from 200 to over 400 found throughout the northern half of the world. *Pinus roxburghaii* belongs to the genus Pinus that has the largest occurring conifers which comprises of about 250 species spreading worldwide [70]. Five species of Pinaceae including *P. roxburghaii* are found in

Pakistan covering the total area of 1,928,000 hectares and spread over the rangelands of North West Frontier, Balochistan and Punjab provinces of Pakistan. Epimedium is a genus of about 60 or more species of flowering plants and belongs to family Berberidaceae widely used as a traditional medicinal herb by China, Korea and Japan. The genus *Hyptis* comprising more than 300 species exhibits major morphological diversity found in tropical and subtropical regions of the world including Bangledash. About 12 ginseng species are distributed all over the world. Commonly used Panax species are *P. quinquefolius* and *P. rootoginseng*. Ginsenosides, the steroid saponins are major biologically active compounds in Panax species, and may play critical roles in its diverse physiological actions. Over 30 ginsenosides have been identified to date. Plants have limitless ability to synthesize aromatic substances, most of which are phenols or their oxygen substituted derivatives. Most are secondary metabolites of which at least 12,000 have been isolated [18]. Aromatic plants dominate Mediterranean type ecosystems. *Eucalyptus canaldulensis Dehn.* (*Myrtaceae*) is a Mediterranean species that is well-known. Northern Cyprus is rich in aromatic plants. The majority of the people living the countryside of the region use naturally grown plants for medicinal purposes. Almost 150 reviewers have been involved in the making of catalogue which holds data on over 9,500 vascular plants that are traded, regulated or otherwise important to international commerce. It is based on 71,700 taxon-literature records held in the GRIN [71]. Use of plants as traditional health remedies is very popular important for 80% of the world's population in African, Asian, Latin America and Middle Eastern countries. Seeds of *Azadirachta indica* have been used by Indians as insect repellent, vermifuge, antimalarial, contraceptive, pesticide and anticancer [72].

4. THREATS TO BIODIVERSITY OF MEDICINAL PLANTS

Evolutionary history and the effect of biodiversity on plant productivity have since been recognized. Therefore, loss of biological diversity because of extinction is one of the most pronounced changes to the global environment [73]. Only a small fraction of the immense diversity of plant metabolism has been explored for the production of new medicines and other products important to human well-being [74]. This is because conservation biology is faced with several controversial issues such as the dichotomy between the preservation of individual species versus a broader focus on the environment, the relative importance to endangered species, the design and management of reserves [75]. Presently, genetically modified plants are widely grown predominantly in North America, Australia, Argentina and China but their regions of production are expected to spread soon to Europe [76]. Deoxyribonucleic acid (DNA) sequencing and finger printing methods have been used for the analysis of plant evolution and diversity in the last twenty years [77].

Climate change impacts directly on plant biodiversity. This could be through warming which lengthens the period of activity and increases plant productivity, and the reduction in water availability. The first may prevail in the north of Iberian Peninsula and the mountains while the second may affect southern half of Spain [78]. Environmental pollution [79] could cause tendency for species richness to decline towards the poles. High levels of environmental energy promote higher species richness nearer the equator. Within flowering plants (angiosperms), families exposed to a high energy load tend to be both more species rich and possess faster evolutionary rates as exemplified by members of Iridaceae in the Cape of South Africa [80]. In China and Mongolia, biodiversity and community composition significantly affect productivity much more than soil composition [81]. However, empirical evidence from the Alaska boreal forest suggests that every 1% reduction in overall plant diversity could render an average of 0.23% decline in individual tree productivity [82]. Vineyards in many parts of the world can be regarded as monocultures with little remaining native vegetation, often with a suite of introduced weeds, and having ecosystem services at a low level [83]. The plants that may likely threatened in India include but not limited to *Holarrhena antidysenterica, Lawsonia inermis, Albizia lebbeckBenth, Gymnema sylvestre, Dalbergia sisoo, Cassia fistula* etc [84].

Fires affect biodiversity in the semi-arid mallee, the cold Tablelands of Casmania, the woodlands of the Australian Capital Territory and coastal heathlands of mainland southern Australia. The relationships between fires, plants and animals have various levels of dependency [85]. But species-poor assemblages have under ranges of possible productivity than more diverse assemblages [86]. Therefore, biodiversity

produces foods, recycle nutrients, regulate microclimate and local hydrological processes, suppression of undesirable organisms and detoxification of noxious chemicals [87].

Although, plants constitute 3.4% of total number of species in the earth, it faces current extinction rate of 100 – 1000 times higher than that of prehumen era. The causes of habitat loss are fragmentation; introduction of exotic species; climate change; over exploitation and pollution. For conservation to be instituted the following steps must be taken into consideration assessment of existing species; causes of decline; management strategies and implementation and monitoring of replacement of declining species [88]. So botanists have a crucial role to play in conservation, bio-processing and sustainable utilization of plant diversity. Because they know about the plants, their distribution, status, importance and methods of conservation [89]. The protection of biodiversity and of ecosystem services should be accorded top priority, because we depend on it fully for ever [90]. The threats to biodiversity are many, but habitat loss is widely recognized as the most important threat and the spread of non-native species is considered the second [91] as invaders can affect biodiversity of native ones on large scale [92]. Phosphorus nutrition of phosphorus-sensitive plants is also a big threat to plant communities in a global biodiversity hotspot [93] in addition to global population, industrialization and deforestation [94-100].

5. CONCLUSIONS

As the world ages, more medicinal plants are being discovered and so exploitation of these medicinal plants by consumers, researchers and pharmaceutical industries have put too much threat to their existence. Hence there is need for conservation policy.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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