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# EFFORTS ON CONSERVATION AND SUSTAINABLE USE OF MEDICINAL PLANTS OF PAKISTAN

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**Abstract**

Since the beginning of civilization, and perhaps as early as Neanderthal man, people have used plants as medicine. Evidence indicates that people used plants to cure themselves, e.g. Chinese Emperor (2800 BC); Babylon (1770 BC); Ancient Egypt (1550 BC). Islamic and Indian physicians also wrote many works prior to 1100 AD and the Seals from the Harappan site in Pakistan (2000 BC) also indicate use of plants. New aspects of medicinal plants need to be studied. For example, we should address the question "why plant diversity declines, when plants with weedy traits become more abundant". This is consequently followed by, species that have traits permitting their persistence in degraded and species-poor ecosystems which are likely to carry high pathogen and vector burdens. Indigenous communities of Pakistan play a vital role in conservation of medicinal plants. Intentionally or unintentionally, people have evolved strategies for doing so in the form of rituals, beliefs and taboos. Various traditional harvesting methods described in one of the study suggest that they were efficient to utilize the natural resources. Our efforts are towards not only providing food security, nutrition and health care to the tribal people, but also to recover, record and diffuse local botanical knowledge and wisdom.

## Introduction

Medicinal plants (MP) are important for the livelihoods of poor communities all over the world. Most of Meicinal plant are flowering plants. Out of the c. 32000 species of higher plants (Prance, 2001), more than 10 percent are used medicinally. Estimates suggest that global medicinal plant business will reach $ 5 trillion (US) by 2050 (Shinwari, 2010). Human beings are not the only ones using medicinal plants, other animals use plants to self-medicate in a process referred to as Zoopharmacognosy. Such ethnobotanical knowledge was acquired by studying animal behavior, particularly with respect to sick animals, and by interviewing indigenous communities. These indigenous people also acquired such knowledge from their elders. Hence such knowledge may have limited authenticity. It is also said that this knowledge was acquired as part of the "doctrine of signatures" which states that plants that resemble various parts of the body can be used to treat ailments of that part of the body.

It should be noted that plants can have synergistic and/or side-effects when used as mixtures Gilani & Atta-ur-Rahman, 2005. Even these days people suffering from the side effects of other modes of treatments, try to find solution in natural products. A number of non-steroidal drugs (NSAIDs) cause deaths and hospitalizations in the U.S. annually. Adverse drug reactions are known to be responsible for 3% to 12% of the hospitalizations in Sweden, and responsible for about 5% of deaths of those patients in US hospitals. Moreover, fatal adverse drug reactions (FADRs) are regarded the seventh most common cause of death in Sweden (Nature: March 17, 2008).

Between 1940 and 2004, over 300 emerging disease events were identified in humans around the world. Concomitantly, some emerging infectious diseases also appeared in wildlife, domesticated animals, and crop and wild plants. Emerging infectious diseases include those in which the pathogen has evolved into a new strain within the same host species, for example, through the evolution of drug resistance (methicillin-resistant *Staphylococcus aureus* or MRSA) or switched to new host species (for example, the human immunodeficiency virus or HIV and the severe acute respiratory syndrome or SARS). In some cases, the switch to a new host species is accompanied by a change in geographic range (for example, West Nile virus in the Americas) (Allan *et al.,* 2009).

Medicinal plants collectors are untrained, and almost half of the material collected by untrained manpower is wasted. Therefore, there is a need to find ways to harvest medicinal plants sustainably from the wild. This includes training local collectors in proper collection techniques, training people to grow medicinal plants, and removing some of the middlemen from the trading chain. Major reasons for the loss of biodiversity are that most people live below the poverty line, and harvest natural resources mindlessly to subsidize their meager incomes.

Pakistan, because of its unique geography with the Hindu-kush Himalayas and Karakorum has altitudes ranging from 0 to 8611m, and therefore has a variety of climatic zones, and rich floral diversity. Pakistan has more than 6,000 species of higher plants (Ali & Qaiser, 1986). At least 12% of the flora is used medicinally and several plants are exported. There is a huge crude drug [Pansara] market system that is entirely dependent on wild plant species. Both human and animal ailments are treated through the use of medicinal herbs. In most instances, certain plant species are considered specific for a particular illness, but occasionally they have mixed usage.

There are 39,584 hakims, 130,000 homoeopaths and 455 vaids registered in Pakistan where about 457 Tibbi dispensaries and clinics provide medication to the public. Among these, 95 dispensaries have been established under provincial departments of Local Bodies and Rural Development. There are 300-350 Herbal/Tibb-e-Unani manufacturing companies and around 300 companies manufacturing homoeopathic medicines. Pakistan is amongst the leading countries exporting medicinal plants (Hussain *et al.,* 2009). These untrained plant collectors and drug stores mostly depend upon their inherited knowledge for the identification of medicinal plants. In may cases closely related species are collected and sold under one name. This adulteration either intentionally or unintentionally does not give desired results. It is therefore utmost important that each and every medicinal plant must be correctly identified and should not be confused with similar morphologically related species. There should be a scientific basis for identification. For this a trained plant taxonomist and good herbaria are necessary. Unfortunately the number of taxonomists and herbaria is decreasing all over the world and so is the case with Pakistan. Major herbaria in Pakistan are shown as Fig. 1.

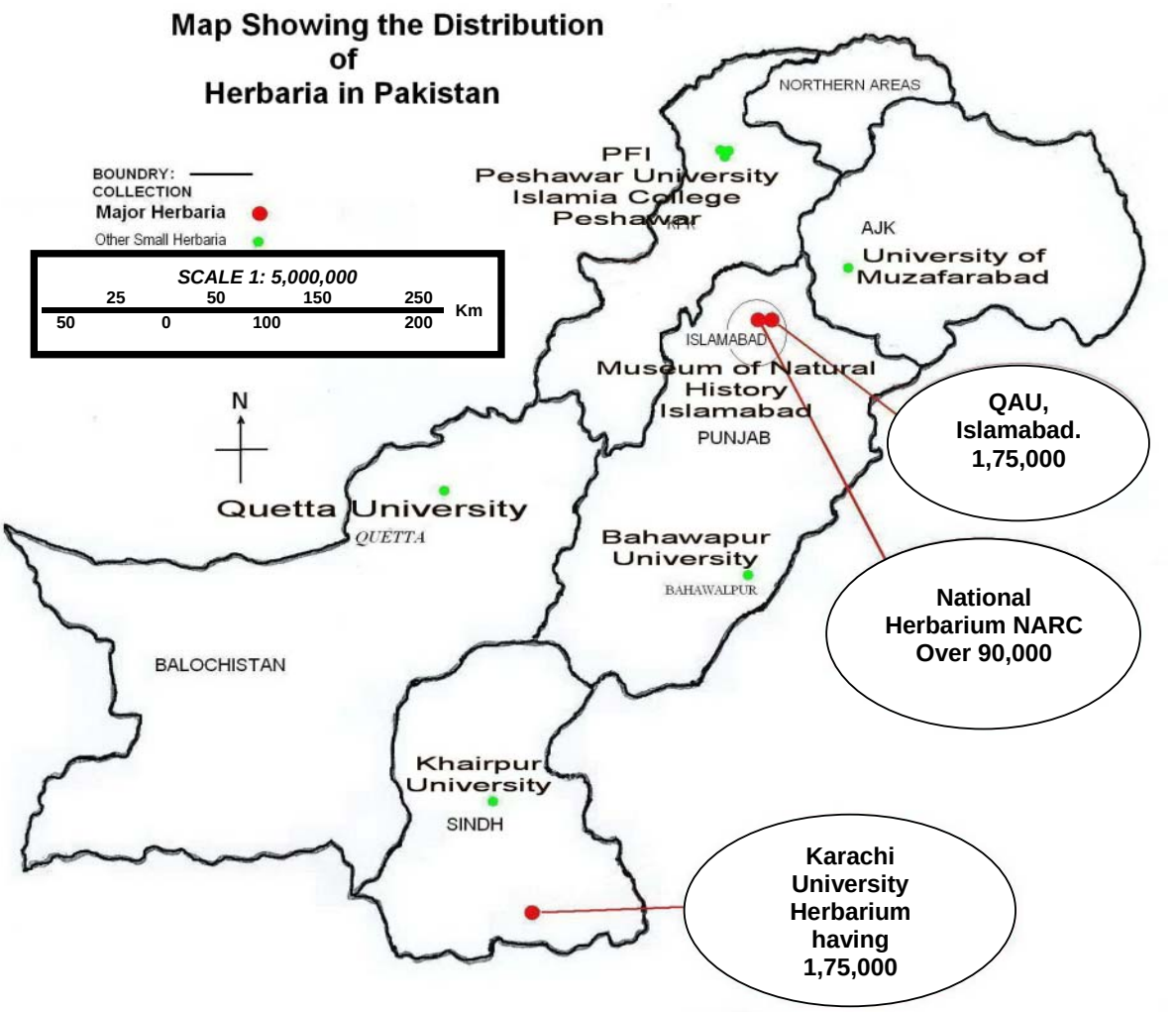


Fig. 1. A map showing the locations of the major and other smaller herbaria in Pakistan

Our group has published several articles on the wealth of medicinal plants in Pakistan (Shinwari *et al.,* 2002, 2003, 2006; Shinwari & Gilani 2003; Hamayun *et al.,* 2006). Other reports also indicate areas rich in medicinal plants (Goodman & Ghafoor 1992; Athar & Siddiqui 2004; Haq & Hussein 1993; Ali & Qaisar 2009).

A recent study has revealed that Pakistan, specially northern Pakistan and Baluchistan not only harbors number of endemic species, but also is the centre of origin and radiation centre of many genera. . such as *Astragalus, Cousinia* and *Allium.* Endemic species, many of them are endangered, may also be explored for ethnobotanical, pharmacological and pharmaceutical activities. The plant hotspots of Pakistan are spread over 13 Natural Regions from alpine pastures to mangrove forest (Shinwari *et al.* 2000, 2002).

**Aspects of Medicinal Plant investigations:** Besides looking for active ingredients and novel compounds, Pakistani scientists have also focused on new aspects of medical plant investigations. The leading academic and research organizations working on medicinal plants in Pakistan are summarized in Table 1. These organizations were strengthened to build their capacity through workshops (Shinwari *et al.*, 1996; Hamilton *et al.,* 2003).

**Chemical and Pharmacological Studies:** A number of studies are available in Pakistan relating to chemical and pharmacological analysis of medicinal plants. These studies include the following: Gilani *et al.,* 2007, Kirbag *et al.,* 2009, Gilani & Cobbin 1986; Gilani *et al*., 2004-2005; Choudhary *et al*., 2005.

**Antimicrobial Activity of Medicinal Plants:** Shinwari *et al*., (2009) reported the presence of (ACE) inhibitory substances in medicinal plants and thus provided a scientific explanation for some of the traditional uses of the respective medicinal plants. The *in vitro* antimicrobial activity of *Justicia adhatoda, Glycyrrhiza glabra* and *Hyssopus officinalis* extracts were studied against selected bacteria by using an agar well diffusion assay. All the species showed activity against *Bacillus subtillus, Escherichia coli, Pseudomonas aeruginosa, Salmonella typhimurium and Staphylococcus aureus*. Tariq *et al.*, (1995) tested medicinal plants for their antimicrobial activities against 25 different pathogens and non-pathogens from Karachi, Sindh Province. *Onosma griffithii* showed potent antileishmanial, moderate antifungal and antibacterial activities that strongly encourage the activity guided isolation of biologically active compounds (Ahmad *et al.,* 2009). Crude ethanol extracts of fruits (seeds) of *Vitex negundo* Linn, showed excellent results (90%) against

*Fusarium solani* which was almost equivalent to a reference drug, while moderate activity was found against *Microsporum canis* (60%) (Mahmud *et al.,* 2009). Jahan *et al.,* (2010) observed greater antibacterial potential in leaves of *Dryopteris chrysocoma* than that recorded in roots and stem. *Thuja occidentalis* showed potent antibacterial activity against all bacteria. The antifungal activity was observed against *Saccharomyces cereviciae, Candida albicans, Aspergillus parasiticus, Macrophomina, Fusarium solani* and *Trichophyton rubrum*. *T. occidentalis* showed antifungal activity against *Saccharomyces cereviciae, Candida albicans, Aspergillus parasiticus, Yersinia aldovae* and *Trichophyton rubrum*. *T. ammi* showed highly potent antibacterial and antifungal activity; no growth was observed on plates. The activity was more than that recorded for the standard drugs i.e. gentamicin, ampicillin, amoxicillin, itraconazole and amphoteracin B. *V. anthelmintica* showed potent antibacterial activity, while it showed antifungal activity only against *Trichophyton rubrum*.

**Table 1. Leading organizations involved in medicinal plant research and conservation.**

| Name of organization/Academics | Resource person | Type of work |
|---|---|---|
| **Khyber Pakhtoonkhwa Province** | | |
| Botany Dept. Peshawar University | Prof. Farrukh Hussain | Taxonomic, Ecological & Ethnobotanical |
| Pakistan Forest Institute (PFI) | | In & Ex. Situ conservation, |
| KP-Agricultural University, Peshawar | Prof. Khan B. Marwat | Ethnobotany |
| Kohat University of Science & Technology | Dr. Javid Hussain | Proximate Analyses |
| Shaheed Benazir Bhutto University, Dir | Prof. Jehandar Shah | Taxonomy and Ethnobotany |
| Hazara University | Dr. Habib Ahmed | Ethnobotany |
| **Punjab Province** | | |
| PMAS Arid Agriculture University, Rawalpindi | Dr. Mohammad Arshad | Taxonomy and Ethnobotany |
| Punjab University, Lahore | Dr. Ghazala Nasim | Antimicrobial Activities |
| G.C University Lahore | Dr. Zaheer-ud-Din | Ethnobotany |
| G.C University Faisalabad. | Dr. Tehreema Iftikhar | Antimicrobial activities |
| Agriculture University Faisalabad. | Dr. M. Ashraf | Ex. Situ conservation |
| **Sindh Province** | | |
| Aga Khan University | Prof. Anwar Gilani | Ethnopharmacology |
| Haroon Ebrahim Jamal Institute of Chemistry Karachi | Prof. M. Iqbal Chaudheri | Chemical Properties of Plants |
| Sindh University, Tandojam | Dr. Tahir Rajput | Taxonomy |
| Khairpur University | Dr. Raza Bhatti | Ex. Situ conservation |
| Karachi University | Prof. Dr. S. Ali | Taxonomy & Ex. Situ Conservation |
| Karachi University | Prof. Dr. Anjum Perveen | Taxonomy & Ex. Situ Conservation |
| Federal Urdu University | Prof. Dr. M. Qaiser | Taxonomy & Ex. Situ Conservation |
| **Federal Capital Islamabad** | | |
| National Agriculture Research Center | Ms. Shahid A. Khalid | Medicinal Weeds |
| Quaid-i-Azam University | Dr. Zabta Khan Shinwari | Indigenous knowledge & Commercial utilization |
| Baluchistan Province | | |
| Baluchistan University | Dr. Rasool Bakhsh Tareen | Ethnobotany |
| **International** | | |
| International NGOS | Ashiq A. Khan | |
| IUCN (International Union for Conservation of Nature) | | Advocacy, Policy Issues |
| WWF-P (World Wide Fund for Nature-Pakistan) | | In-situ Conservation |
| SDC(Swiss development Corporation) | | Socio-economic uplift |
| **Leading Herbal Industries** | | |
| Qarshi Industries (Pvt) Ltd. Lahore, | | |
| Hamdard Industries, Karachi | | |
| Marhaba Industries, Lahore | | |
| Ashraf Laboratories, Faisalabad | | |

**Proximate Analyses:** Proximate analysis of a plant sample determines the total protein, fat, carbohydrate, ash, and moisture reported as the percentage composition of the product. It is not just a spiritual link between humans and plants (Juden, 2003) given that many plants are good sources of edible fats, proteins, and carbohydrates and thus have nutritive and calorific values. Carbohydrates serve as easy sources of energy. Fats also provide energy while also serving to enrich a meal's flavor, make it more satisfying, and delay the onset of hunger. Proteins are usually required for the proper functioning of the human and animal systems (Hussain *et al.,* 2009).

**Free radical scavenging activity:** Free radical scavenging activity can be done by the 2,2-diphenyl-1-picrylhydrazyl radical (DPPH) test. Methanolic extracts of medicinal plants at different concentrations can be used to see the maximum and minimum inhibitions of free radicals. It is known that high levels of reactive oxygen species cause damage to cells involved in human diseases such as cancer, neurological degeneration, arthritis and accelerate the aging process. Some medicinal plants of certain genera (e.g. *Peganum*, *Terminala, Aloe, Emblica*, *Nepeta*, *Rosa, and Smilax etc.)* show high antioxidant activity. Oxidative damage is a crucial causative factor implicated in several chronic human diseases, mainly cardiovascular diseases, rheumatism, diabetes mellitus and cancer (Pong, 2003).

**Ex situ conservation:** The Higher Education Commission (HEC) of Pakistan has financially supported all public sector universities in Pakistan to establish a botanical garden to promote *ex situ* conservation. Some universities at Karachi, Khairpur, GCU-Lahore, Faisalabad and Peshawar have taken advantage of this opportunity and currently are engaged in developing their botanical gardens. However, several impediments exist in establishing these gardens as shown in Table 2.

**Table 2. Impediments to the establishment of Botanical gardens in Pakistan**

- Funding for Botanical Gardens is insufficient
- Not enough taxonomists, field botanists
- Taxonomy is difficult to learn and to practice
- Requires years to accumulate literature, specimens etc.
- Critical resources are scattered and available to only a few workers
- Literature is one such critical resource
- Herbarium specimens are another such critical resource
- There are few centralized sources of information
- Lack of sharing information
- Lack of trained Human Resource to domesticate wild plants

**Discussion**

Biodiversity is rapidly declining worldwide (Butchart *et al.,* 2010). The decrease in ecosystem functioning is due to reduction in biodiversity. It remains unclear how many species in an ecosystem are needed to properly sustain ecosystem services (Isbell *et al.,* 2011). Biodiversity loss may promote infectious diseases. Infectious diseases include a host and a pathogen; however, additional species may be involved, including additional hosts, vectors and other interacting organisms. For example, West Nile virus is transmitted by a virus for which several species of passerine birds act as hosts. Allan *et al.,* (2009) reported that there is a link of loss of bird diversity and increase human risk or incidence of West Nile encephalitis disease in the United States.

Plants provide alternate ways to deal with different problems. For example, an active chemical from peppers (capsaicin) allows painkilling without affecting other sensations (Binshtok *et al.,* 2007). It can prove useful for situations where patients require anesthetic, but also need to be able to move or control muscles, such as in childbirth and in some dental procedures. Such knowledge remained prevalent in the Muslim world and its possible transfer mechanism is shown in Fig. 2.

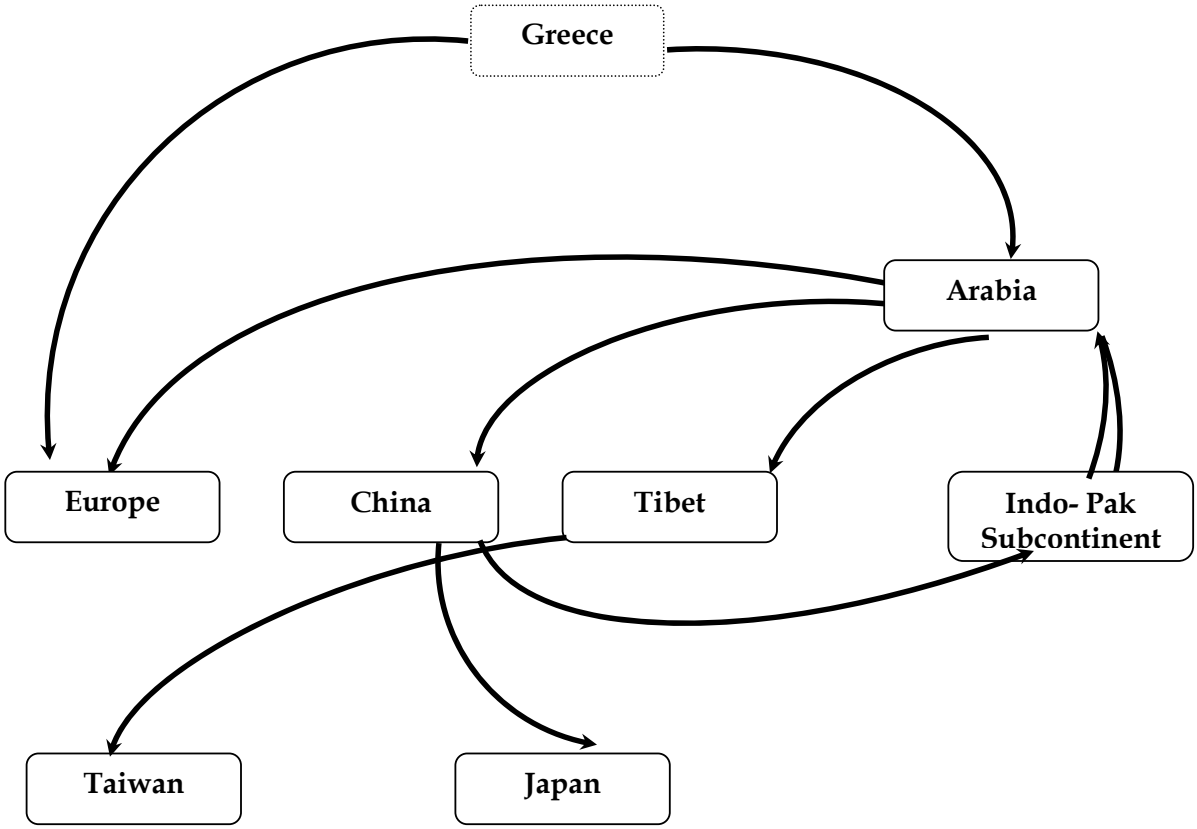


Fig.2.Trade chain of medicinal plants showing its possible origin from Greece.

Recently there is surge in certain diseases like diabetes which is a common metabolic disease characterized by abnormally high plasma glucose levels, leading to major complications, such as diabetic neuropathy, retinopathy and cardiovascular diseases (Gao *et al.,* 2008). In India, which now has a similar food consumption habits as that of Pakistan, the average age-adjusted prevalence of diabetes is 8% higher than that in most European countries in 2010 (Shaw *et al.,* 2010). Historically by contrast, large Indian cities that are today diabetes strongholds had a prevalence of diabetes just 1% or less compared to European countries in 1938 and 1959. Only in the 1980s did those numbers start to rise, first slowly and now explosively (Pradeepa *et al*., 2010).

Many species have been investigated to cure diabetes. For example, the leaves of *Diospyros kaki* Thunb., *Rubus* sp. are commonly used in Nepal (Bhattarai *et al*., 2006), while *Ficus* spp.*, Smilax* spp. and *Olea europaea* have long been known as diabetes remedies in the Mediterranean and India (Azazieh *et al.,* 2006). Olive is being used to regulate glucose levels. Other studies refer to artichokes (*Cynara cardunculus*,) (Linde *et al.,* 2001), chickpeas (*Cicer arietinum*) (Cummings 1973), *Ocimum* sp. (Egsie *et al.,* 2006), *Citrus* spp. (Jaiyesimi 2000*), Phyllanthus* spp. (Ali *et al.,* 2006), *Ficus* spp. (Ogunleye *et al.,* 2003), ginger and banana (*Zingiber officinale* and *Musa* x *paradisiaca*,) (Ojewole, 2006), walnut (*Juglans regia*,) and *Cestrum* sp. (Capen, 1980) as potential diabetes remedies. All the plant material comes from the wild and little effort has been made for their cultivation (Schippmann *et al.,* 2002)

**Future Directions:**

We have to focus on issues related to:

- Herbal medicine effectiveness and safety
- Taxonomic issues, use of DNA barcoding
- Use of modern technology
- Scientific confirmation of indigenous knowledge
- Sustainable use of medicinal plants
- Reduction in post-harvest losses
- Value addition to raw material
- Bringing different stakeholders together (University-Industry)
- Policy issues relating to large scale cultivation and conservation

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