REVIEW ARTICLE

Phytotherapy in India: transition of tradition to technology

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Abstract
The disease preventive and health promoting approach based on herbal medicine takes into consideration, the promotion of health and treating ailments is holistic way and finds increasing acceptability in many regions of the world. India and China being in the forefront. The practice of herbal medicine basically depends on folklore and by experiences of people over a long period of time. However, very little research especially in the area of basic science has been conducted in a systematic manner. Medicinal plants with a long history of safe and effective use are likely to have a pharmaceutical effect. The use of plants in traditional medicine can be explained by physiologically active phytochemical compounds of a species and also by its ascribed meaning in a culture. Plants produce a great diversity of substances that could be of therapeutic significance in many areas of medicine. However, the chemical nature of plant compounds present naturally as such and in extract, is puzzling. It is important to know constituents of plant extracts and their relative importance in their therapeutic value. The alkaloids and other compounds are characterized and tested for their medicinal value from these plants which include not only the unexplored tribal plants but also the spices, condiments and vegetables which are already in use. In last decade, there is a renewed interest in the development of herbal drugs underlined by the understanding of mechanism of action rather than based on faith and folk, as it happened in past. Several aspects on integrated approaches of drug development from herbs have explored many potential lead phytochemicals. Nonetheless, even the limited number of mechanistic experiments reveals that numerous mechanisms are likely involved in the various actions of even a single herbal medicine. It will be the elucidation of such mechanisms that will provide the scientific basis for establishing the efficacy and safety of not only Chinese and Indian herbal medicines but all forms of medicinal botanicals.

Introduction
Plants are providing humankind with all needs including food, clothing, shelter, flavours and fragrances as not the least, medicines. Plants form the basis of traditional medicine, Ayurvedic, Unani, Chinese amongst others. Medicinal plants have been used throughout the world, however, their wide usage had been limited to China, India, Japan, Pakistan, Sri Lanka, Thailand and African countries. Developed countries are also turning to encourage the usage of plant-based natural medicinal product in their healthcare systems. World Health Organisation estimates that 80% of the world’s inhabitants rely mainly on traditional medicines for their health care (Farnsworth, 1994; Mukherjee and Wahil, 2006). Plant products also play an important role in health care systems of the remaining 20% of the population, mainly residing in developing countries. The Natural Health Product Regulations of Canada promulgated in January 2004 is an important step toward modernization of plant-based product usage in healthcare (Siow et al., 2005). This regulation encourages usage of modern technology and evidence-based scientific support toward promoting medicinal plants and the associated products. With the advancement of Ayurvedic tradition and its scientific exploration, several classes of plant species have been studied in order to evaluate their therapeutic potentials and to isolate the lead compounds.

Folk medicine in India
Folk medicine is the mother of the healing systems of India (Valiathan, 2006). It is universally accepted now that traditional health care systems have their unique strengths and are worth exploring for their potential preventive and curative properties. Herbal remedies are considered the oldest forms of healthcare known to mankind on this earth. Prior to the development of modern medicine, the traditional systems of medicine that have evolved over the centuries within various communities, are still maintained as a great traditional knowledge base. Traditionally, this treasure of knowledge has been passed on orally from generation to generation without any written document (Perumal Samy and Ignacimuthu, 1998, 2000), and is still retained by various indigenous groups around the world. In India, there are about 54 million indigenous people of different ethnic groups inhabiting various terrains. These indigenous groups possess their own distinct culture, religious rites, food habit and a rich knowledge of traditional medicine (John, 1984; Pushpangadan and Atal, 1984; Anuradha et al., 1986; Harsha et al., 2002; Parinitha et al., 2003). Even today, indigenous and certain local communities practice herbal medicine to cure a variety of diseases. Traditional system of medicare is still practised by the people of rural areas as they are safe, no adverse effects, inexpensive and ease availability. However, a gradual decline in practice of traditional herbal medicines has been reported in the recent past. Hence, there is an urgent need to investigate in detail the indigenous
ethnobotanical knowledge held by each tribal people before such valuable knowledge disappears. Further, it is also necessary to conduct scientific investigations to understand the mechanism of action.

**Herbal reservoir**

There are more than 20,000 species of higher plant, used in traditional medicines and are reservoirs of potential new drugs. As the modern medicine and drug research advanced, chemically synthesized drugs replaced plants as the source of most medicinal agents in industrialized countries. Nevertheless plants are an important source of lead compounds. However, in developing countries, the majority of the world’s population continues to rely on plant-derived pharmaceutical drugs and use them as their own plant-based indigenous medicines. In recent times, focus on plant research has increased all over the world, and a large body of evidence has been collected to show the immense potential of medicinal plants used in traditional systems. Various medicinal plants have been identified and studied using modern scientific approaches. The results revealed the potential of medicinal plants in the field of pharmacology (Tapsell et al., 2006; Triggiani et al., 2006),

The use of plants in traditional medicine can be explained by physiologically active phytochemical compounds of a species and also by its ascribed meaning in a culture. Medicinal plants with a long history of safe and effective use are likely to have a pharmaceutical effect (Tabutii, 2008). In addition, the likeliness of a medicinal use being based on pharmacological properties rather than on a cultural context increases when this use is repeatedly found in different cultures.

According to Gurbil-Fakim (2006) there are four basic ways in which plants that are used by tribal peoples are valuable for modern medicine: 1. Plants used as sources of direct therapeutic agents 2. Plants are also used as sources of starting points for the elaboration of semi-synthetic compounds 3. Plants can serve as sources of substances that can be used as models for new synthetic compounds. 4. Plants can also be used as taxonomic markers for the discovery of new compounds.

**Recently explored medicinal plants - examples**

Many plants have a long use in traditional Ayurvedic medicine for several diseases and the scientific studies are reconfirming them with modern relevance. The scientific basis for the statement that plants and their active constituents play an important role in the prevention of chronic and degenerative diseases is continuously advancing. In fact, the origin of many therapeutic substances is due to secondary metabolism in the plants.

A wide range of secondary metabolites including triterpenoids, flavonol glycosides, anthocyanins and steroids has been isolated from this plant (Yadav et al., 2010). Partially purified extracts of Aristolochia indica, Hemidesmus indicus, Gloriosa superba, Strychnos nux-vomica, Eclipta antisyphilitica have been shown to possess activity against HIV-1 infection and for the treatment of inflammatory disorders. The major biochemical constituents of W. somnifera are steroidal alkaloids and lactones, a class of constituents together known as withanolides (steroidal lactones with ergostane skeleton) (Elakka et al., 1990). So far 12 alkaloids, 35 withanolides and several siteindoles have been isolated and their structures have been elucidated (Mishra et al., 2000; Matsuda et al., 2001). The various alkaloids include withanine, seneconine, somniferine, withanotropane, psuedowithanine, tropine, psuedotropine, 3-α-glycoxytopane, choline, cuscohygrine, isopelletierine, anaferine and anahydrine.

The genus Hibiscus contains 220 species distributed around the world. It is an interesting source of potential bioactive molecules, as phenolic compounds, triterpene derivatives, physostigmines, antitumor, antioxidant, cardioprotective, antihypertensive and antiproliferative activities (Magana et al., 2010). Pharmacological investigations of the genus Hibiscus indicated the presence of some species with useful biological activities as antihypertensive, anti-inflammatory, antipyretic, hepatoprotective, anti-diarrhoeic, anti-spermatic, anti-tumour, antidiabetic, anticonvulsant, antiinflammatory, antimalarial, antioxidant and antiinfective agents (Sachdeva and Khemani, 2003). Amongst these species, less than 15 have had their biological effects studied. The majority of these studies mainly concentrated on Hibiscus sabdarifif.

**Euphorbia fusiformis** a dwarf perennial herb, grows wild in western peninsular India and warmer parts of eastern India. The plant is of recent discovery from Tamil Nadu (Yadav et al., 2002). The dried root powder and fresh rhizome have been found to increase secretion of mother’s milk. Extract of dried rhizome is also administrated orally for relief from joint pain and rheumatism and it is more effective against diarrhea. Fresh latex is externally applied to heal chronic wounds and cracks and to cure skin diseases. Crushed leaf poultice is applied on forehead to get relief from acute inflammation related diseases. The ethno-medicinal studies have reported that this species possess effective anti-inflammatory (Singh et al., 1984) and antimicrobial (Natarajan et al., 2005) properties. Recently, Anusuya et al. (2010) justified the
traditional claims and assessed the hepatoprotective effect of *Euphorbia fusciformis* tubers employing rifampicin intoxicated rat model and also assessed its safety upon administration. The use of different parts of *Ricinus communis* for the treatment of various diseases in traditional or folk remedies throughout the world has been reported. In the Indian system of medicine, the leaf, root and seed oil of this plant have been used for the treatment of inflammation and liver disorders as they have been found to be hepatoprotective (Visen et al., 1992), laxative (Capasso et al., 1994) and diuretic (Abraham et al., 1986). The antifertility activity of 50% ethanolic extract of *R. communis* has also been reported (Sandhyakumary et al., 2003). Shokeen et al. (2009) reported the antidiabetic activity of 50% ethanolic extracts and purified fractions of *R. communis*.

Since a long time, medicinal plants have been used for the treatment of many infectious diseases without any scientific evidence. At present there is more emphasis on determining the scientific evidence and rationalization of the use of these preparations. Research is in progress to identify plants and their active principles possessing activity against sexually transmitted pathogens including human immunodeficiency virus (HIV) with an objective of providing an effective approach for prevention of transmission and treatment of these diseases (Mukhtar et al., 2008).

In VIT University, characterization and testing of herbal extracts, and their purified or fractionated extracts are under forensic investigation. Anticancer properties of plants like *Oxyroclinium indicum*, *Acacia nilotica*, *Bacopa monnerei*, *Picrorhiza kurroa* was studied using cancer cell lines. Methanolic and aqueous extracts of *O. indicum* was found to exhibit cytotoxic effect to cancer cell lines. The aqueous extract with its antioxidant activity exhibited DNA protection against free radical damage. *Costus pictus* which is popularly called as ‘insulin plant’ was investigated for its antidiabetic and antioxidant properties. Experiments on liver and kidney cells of diabetic rats indicated that this plant extracts do not have any cytotoxic effect in normal and cancer cells. The inhibitory activity on carbohydrate hydrolyzing enzyme might be attributed to the mode of action of this plant extract. In yet another study, the extracts of triphala was found to have anti-arthritis, analgesic effect, anti-pyretic action and anti-ulcerogenic activity. *Acacia nilotica*, *Cureuma longa* and *Lawsonia inermis* showed antioxidant activity which validates their potential role in alleviating cancer. *Costus pictus*, the insulin plant, showed significant reduction in FPG level of STZ induced diabetic rat and significant reduction in serum and organ lipid level suggesting the hypolipidemic activity of this plant. Significant effect on TNF-alpha production, humoral antibodies, lymphocyte proliferation and delayed type hypersensitivity were observed in arthritis rats administered with extract from *Triphala*, indicating the immune-modulatory function of this plant. Administration of triphala extract in animal models proved to be efficacious, specific and non toxic and hence warrants further investigation, before development of drug formulations.

**Formulations and Testing**

Testing the biological activity of medicinal or potentially medicinal plant materials demands a special approach. Investigations may be focused on understanding the bioactivity, or a compounded plant extract or simply directed at isolating a single bioactive chemical compound. In the latter case, results often lead to oversimplification or wrong explanations or the bioactivity or extract preparations. On the other hand, thorough studies on single bioactive constituents provide important information for plant drug research. However, the much more complex array of molecular interactions and bioactivity mechanisms that arises from plant extracts represents a much greater and more fascinating challenge to science. Reverse pharmacology and herbal drug formulation The traditional knowledge-inspired reverse pharmacology described here relates to reversing the routine ‘laboratory-to-clinic’ progress to ‘clinica-laboratory’. Pathak and Memon (2009) suggest that drug discovery need not be always confined to the discovery of a single molecule. Many analysts believe that the current ‘one drug fits all’ approach may be unsustainable in the future. The growing interest in polypill concept is indicative of the need to collectively address multiple targets, risk factors or symptoms.

The FDA and a few other agencies have come up with practical guidelines for botanical ‘drug’ development. A botanical drug product often has unique features and may include complex mixtures with as yet unknown active ingredients. No botanical products are, however, presently being approved or marketed as prescription drugs. The FDA recognizes that prior human experience with botanical products may be documented in many different forms and sources, some of which may not meet the quality standards of modern scientific testing. The FDA, maintains, however, the same standards for safety and efficacy for marketing approval whether it is a botanical-sourced product or a purified chemical.

Traditional herbal formulations could follow such regulatory guidance to create scientific evidence base with robust chemistry, manufacturing and controls. Department of Ayurveda, Yoga, Unani, Siddha, Homeopathy (AYUSH) in India has recently established a Research Center at the University of Mississippi, Oxford, MS, USA to facilitate scientific investigations on Indian herbal drugs. Such efforts should help improve quality assurance, enhancing the chance of regulatory approvals and improving the acceptance of botanical drug products and formulations.

**Concluding remarks**

The use of herbal drugs for the prevention and treatment of various health ailments has been in practice from time immemorial. Many plants belonging to varied geography are being studied in large to identify the compounds of medicinal value. However, the researchers are still finding difficulties in characterizing the compounds from the pool of plant metabolites for a specific activity. The crude extracts of many plants are reported to have multi-functional effect on diseases and disorders. The relative efficacy of each compound and the possibilities of purifying them to homogeneity and developing a drug formulation is still beyond reach. Moreover, generally it is believed that the risk associated with herbal drugs is very less, but reports on serious reactions are indicating to the need for development of effective marker systems for isolation and identification of the individual components. Standards for herbal drugs are being developed worldwide but as yet there is no common consensus as to how these should be adopted. Standardization, stability and quality control for herbal drugs are feasible, but difficult to accomplish. Further, the regulation of these drugs is not uniform across countries. There are variations in the methods used across medicine systems and countries in achieving stability and quality control. The search for new molecules, nowadays, has taken a slightly different route where the science of ethnomedicine and ethnopharmacology are being used as guide to lead the biotechnologist towards different sources and classes of compounds. With intense research on the herbal compounds from our huge natural wealth, the development of herbal medicine technology for every of our diseases and disorders in not far from now.

**References**


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