

Ancient and Modern Medicinal Herbs: China

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Chinese medicine represents one of the oldest therapeutic systems in the world. Its roots date back more than 4,000 years and many of the seminal works still used by its practitioners today are based on findings made and recorded 2,500 or more years ago.

Put in the simplest of terms, the underlying principal of Chinese medicine is that human beings are at their happiest and healthiest when in harmony with the natural environment. This harmony can be achieved by maintaining the body's natural "elements" in balance through the wide use of medicinal herbs and such practices as acupuncture and acupressure.

In recent decades, Chinese medicine's holistic approach to health has made it increasingly popular with people living in Western countries. Chinese medical techniques, on their own or in conjunction with those of other holistic or conventional practices, are now used throughout Europe and North America to treat people suffering from a wide range of conditions and complaints.

This means that China's traditional medicinal products have become a valuable potential economic resource. It also means that age-old products are being scientifically scrutinized as never before to bring them in-line with the demands of modern medical practices and standard.

It seems fitting, therefore, that since 1996 China's Institute of Medicinal Plant Development (IMPLAD) in Beijing should be working on ways to preserve and support the use of the country's rich heritage of medicinal plants. To make their work even more relevant to the needs of a fast-developing country, IMPLAD directed its 1996-1999 programme towards the joint goals of sustainable development and environmental protection.

The ambitious series of projects was divided into three main sections, each with a wide range of aims:

- Cultivation of Chinese medicinal plants aimed at establishing a germplasm- and gene-pool for medicinal plants; promotion of research on medicinal plant germplasm resources and the breeding of fine varieties; development of large-scale farms where medicinal plants can be cultivated according to prevailing methods and standards; establishment of manufacturing centres to process medicinal plants in an environmentally friendly way; pursuit of new research cultivation techniques as an alternative to harvesting wild medicinal plants; and application of biotechnology for improving the cultivation and usefulness of medicinal plants.
- Research and development of new drugs aimed at conducting research to find out the chemistry of natural products; testing on animals; and conducting clinical tests.
- And research and development of traditional medicine aimed at establishing effective dosage methods and quantities for Chinese plant products; identifying the plants used; uncovering the bioactive ingredients that make those plants medically useful; improving quality standards; and advancing the equipment and methods used to process the plants into medical products.

Background and Justification

Until the early 1990s, Chinese government policy for science and technology paid little attention to the international market and tended to neglect ecological issues, forcing institutions to concentrate all their efforts on the more high-technology end of research. IMPLAD found itself side-lined and undervalued. Since its foundation in 1983, a lack of funds had prevented it from conducting any major national projects, while the provincial projects it did carry out were restricted by inadequate facilities. The institute's pharmaceutical factory, for example, had poor, outdated production equipment, unsatisfactory quality-testing methods and inefficient machinery for processing the plant products.

At the same time, government and general interest in traditional medicine had dissipated to virtually nothing. Many Chinese medical practitioners had left the country or changed professions, leaving

both wild medicinal plants and traditional knowledge to degrade and decrease. Local people had forgotten how to use the plants, while a combination of poverty and lack of ecological consciousness made them unlikely to do much about protecting the environment and its, to them, apparently useless plant-life. Wild plants that were known to be useful were harvested indiscriminately. In the meantime, many of China's best-qualified and most able scientists had left their native country to take up more fruitful and lucrative scientific and technological research posts elsewhere.

The mid-1990s, however, marked a notable change of direction. Like other countries throughout the world, China awakened to the environmental and economic importance of its natural resources and began to see how essential it is to protect and sustain them. Among those resources are medicinal plants with their massive international market and ecological potential.

Suddenly, IMPLAD emerged as the ideal institution for a large-scale national project and, in 1996, it received funding to launch its Research and Development of Medicinal Plants and Sustainable Development of the Ecological Environment programme, involving numerous individual projects centered on a wide range of aspects of Chinese medicinal herbs.

Description

One of IMPLAD's first priorities was to rescue plants on the verge of extinction. Working with three branch institutes, it established a botanical garden for medicinal plants in which 3,800 species are now represented. This 270-hectare garden will serve as a prototype for a range of gardens that IMPLAD and its branch institutes plan to establish by 2010 as sources for germplasm gene pools and medicinal plants. The ultimate goal is to ensure that valuable species are not left to fight for their own survival in the hostile, degenerating wild.

Research into medicinal plant germplasm resources and the breeding of fine varieties is another important thrust of the project. With help from the State Administration of Traditional Chinese Medicine and several provincial manufacturing units, IMPLAD experimented with new ways of cultivating medicinal plants, including such fine varieties as *Panax ginseng* CAM (ginseng), *Salvia miltiorrhiza* Bunge (sage), *Carthamus tinctorius* (safflower), *Scutellaria baicalensis* Geogr. (skull cap) and *Trigonella foenumgraecum* (fenugreek).

Large well-managed centres practicing tried and tested cultivation methods were set up at several provincial and IMPLAD gardens. These centres, following standard techniques, have found ways of raising some wild species that had never been cultivated in captivity before. Thanks to this initiative, manufacturers now have a ready supply of high-quality medicinal plant materials that can be used sustainably.

To make sure that the plants are beneficial to humans and the environment (in particular, that they are free of all harmful pesticide and bactericide residues and have a low heavy metal content), research was directed towards developing environmentally friendly ways of controlling pests and diseases. As a result of this research, IMPLAD was able to establish a "green" medicinal plant manufacturing base in Hebei Province, where integrated pest management is followed.

Biotechnology is a useful tool when rare and precious medicinal plant species are being conserved and improved, or regenerated through *in vitro* culture. As a result, IMPLAD has explored the potential for using tissue culture techniques. Thus far genetic engineering has managed to bring about some exciting increases in the yields of useful ingredients from *Salvia miltiorrhiza* plants through a complex process called plasmid transformation that involves the transfer of the t-DNA contained in the plant's plasmid to the genomic DNA of the plant's cells.

Although many Chinese medicinal plants have been used successfully in China and elsewhere for centuries, if not millennia, they have never been subjected to the stringent tests and analyses that are demanded of Western medical products. To make traditional and innovative plant products completely acceptable to conventional medicine, IMPLAD has carried out quantitative and qualitative analyses to identify the bioactive ingredients of Chinese plant medicines and the active constituents of medicinal plants. In other words, scientists have found out which of the chemical substances contained in the plant are responsible for its beneficial health effects. Among its other tasks, the newly established Chinese Academy of Medical Sciences has started to investigate suitable animal species to use in Chinese drug

tests. Clinical trials that take account of the special, holistic nature of Chinese medicines are also being developed.

Dosage methods and quantities were rigorously examined by specialized scientists with experience of working in Western countries, and dosage levels that are effective, yet small and convenient, have been developed. Large amounts of money and human resources have been committed to improving manufacturing conditions and the overall quality of production — from plant to finished product.

Publications

Since the start of the programme, more than 1,000 papers have been published in China and abroad. Some 30 monographs have also been published, including *Chinese Materia Medica*, *A Pictorial Encyclopaedia of Chinese Medicinal Herbs*, *The Cultivation of Medicinal Plants in China*, and *Application of Mass Spectrometry in Natural Product Chemistry*. In addition, scientists at IMPLAD have won numerous scientific research awards from the Ministry of Health and state authorities, and have overseen the work of several students receiving Ph.D. and M.S. degrees in pharmacognosy granted by the State Council Degree Committee.

Patenting and Commercialization

Among the patents awarded to IMPLAD is one for new Shikimate compounds and another for the manufacture of general annonaceous acetogenins as anticarcinogens and pesticides. On the basis of its research results, IMPLAD has entered into joint ventures with three commercial companies: PUMC Ruicao, Natural Pharmaceutical Co. Ltd, and Beijing Uniphar Pharmaceutical Co. Ltd.

Partnerships

Three branch institutes have been set up in subtropical southern China in the provinces of Yunnan, Hainan and Guangxi. A 17-hectare botanical garden containing 1,200 species of medicinal plants and a herbarium house with more than 5,000 specimens also has been established.

Internationally, IMPLAD enjoys a good reputation and is involved in academic exchanges of scientists and information with some of the world's most prestigious pharmaceutical companies, scientific organizations and academic institutes.

Replicability

Poverty, disease and underdevelopment are all common social problems in developing countries. These factors play a significant role in environmental degradation through the uncontrolled harvesting of wild plants and other natural resources by people who depend on those plants for survival and do not understand the importance of protecting the ecological environment. By working on specific issues of medicinal plant conservation, protection and improvement, IMPLAD projects have succeeded in controlling the rapid loss of biodiversity and traditional knowledge of the uses of plants. This has contributed to alleviating both socio-economic and ecological problems associated with environmental neglect and degradation.

Similar projects would be just as helpful to other developing countries. Countries with common problems could collaborate with one another to find and implement effective measures for dealing with those problems. Drawing up collective lists of protected species and carrying out joint regular monitoring exercises are examples of useful early steps in this process.

Lessons Learned

Lack of funds and the scientific brain-drain are still serious problems in China. Nevertheless, IMPLAD financed its projects through a combination of sources. It applied for a wide range of government and other funding, established joint ventures and limited its non-technical staff to the absolute minimum. At the same time, it made efforts to attract scientists from China and abroad by providing good living and working conditions and adequate research funds.

Before the project began, the growing demand for Chinese medicinal plants at home and abroad was leading to uncontrolled harvesting of wild resources and, subsequently, not only to the extinction of species but to the desertification of vast tracts of land. When one plant species disappears, the effects can be ecologically devastating on the entire surrounding area, as was seen in northwest China where excessive collection of licorice and *Ephedra* (the anti-asthmatic Ma Huang) caused grassland degradation, loss of water supplies and soil erosion. Protecting species that are at risk of extinction and developing sustainable ways of producing medicinal herbs are two of the most useful ways of turning a potential environmental disaster into an economic opportunity, particularly when they are combined with activities to build gene pools and raise public awareness of the importance of plant protection and cultivation.

The projects' success has also been bolstered by the Chinese government's approval of a series of laws and regulations aimed at protecting the environment, including The Grassland Protection Law, Protection of Species on the Verge of Extinction Law, and Chinese Drug Law, which rank among the most significant environmental legislative measures taken to date.

Impact

IMPLAD's notable successes with medicinal plants have made it a nationwide leader in many research areas. A high-level team of scientists in the fields of cultivation and drug development has been assembled. The drug designing and pharmacopoeia division is conducting useful work in such areas as synthetic drug design, natural product chemistry, pharmacology, toxicology, dosage form and quality control. At the same time, an enthusiastic team of young, qualified scientists is working in the area of biotechnology. A new method that IMPLAD designed to test pesticide residues and heavy metal content is now being widely used.

Among its most significant findings to date are those relating to quality standardization of 23 medicinal plants (1996), effects and safety of cinnabar in Zhusha Anshen Wan, and a database of Chinese material and prescriptions (both 1998).

Recognition of IMPLAD's growing importance can be seen in terms of the funding it has received, which increased from 500,000 RMB (US\$60,400) in 1996 to 2 million (US\$242,000) in 1998.

Future Plans

IMPLAD's plans for the future include:

- Creating centres where medicinal herbs can be cultivated using standard methods.
- Establishing quality standards, quality testing and market supervision for seeds and seedlings.
- Increasing the use of biotechnology in medicinal plant cultivation.
- Advancing research in medicinal plant germplasm resources and the breeding of fine varieties.
- Continuing research in new cultivation techniques so that wild plants do not have to be harvested.
- Launching an international Chinese medicinal plant detection centre in collaboration with the Royal Botanical Gardens at Kew in the United Kingdom.
- Creating a quality detection centre in collaboration with a similar institution in India.
- Continuing the ongoing Chinese drug sift programme with the University of North Carolina in the United States.
- Building a natural product research centre in collaboration with Poland.
- Promoting efforts to protect ecological systems.
- Developing a multi-disciplinary approach to sustainable development.

Implementing Institution

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