

Introduction

Many cultures throughout the world rely on indigenous medicinal plants for their primary health care needs. Moreover, one quarter of modern medicines are made from plants first used by traditional medical practitioners. Among the products that have been derived from medicinal plants are the anti-cancer drug, taxol, extracted from the yew tree (*Taxus*), and two anti-leukaemia drugs extracted from the Madagascar periwinkle (*Catharanthus roseus*). It is interesting to note, however, that Madagascar, the source of the periwinkle plant, did not benefit from payments or royalties from the pharmaceutical company that developed these highly profitable drugs. International agreements such as the Convention on Biological Diversity, which promotes "the fair and equitable sharing of the benefits arising out of the utilization of genetic resources", have since given countries sovereign rights over their indigenous biodiversity. Even so, issues relating to intellectual property rights are an integral part of developing pharmaceutical products from medicinal plants.

Given the vast amount of traditional knowledge of many communities in developing countries pertaining to the use of medicinal plants and the wealth of plant biodiversity present in these countries, there are many opportunities to develop products that can be sold on both local and international markets. This is especially the case since, to date, the natural resources of many developing countries have not been well studied. Plant secondary metabolites, for example, are a largely unexplored resource that could provide a wealth of new drugs to treat such ailments as malaria and other infectious diseases, cancer and diabetes.

Apart from the obvious benefits of improving health care throughout the South by developing new medicinal products, there are also potential financial benefits. The global market for herbal medicines alone is currently worth more than US\$60 billion a year and continues to grow steadily. The market for allopathic medicines derived from medicinal plants is also enormous. In addition,

the market for antimicrobial agents is now worth more than US\$25 billion per year. However, the global emergence of resistance to antimicrobial agents — antibiotic-resistant bacteria have been found in nearly every country in the world — is increasingly limiting the effectiveness of current drugs. New compounds to combat this problem are in great demand, especially as past experience indicates that bacteria can quickly develop resistance to new drugs. The problem has been exacerbated as no new classes of antibiotics were released in the 37 years between the introduction of nalidixic acid in 1962 and linezolid in 2000. All of the antibacterial agents that entered the market during this period were modifications of existing molecules.

The knowledge-sharing process promoted by the partnership between UNDP and TWNSO includes an international workshop and the publication of a volume in the series, *Sharing Innovative Experiences*. The objective of the International Workshop on the Development of Pharmaceutical Products from Medicinal Plants in the Developing World, therefore, was to bring together scientists with experience in searching for and developing pharmaceutical products from medicinal plants indigenous to developing countries so that they could exchange ideas and benefit from one another's successes. The workshop highlighted several areas for discussion:

- *importance of traditional knowledge.* Activities should focus on collecting indigenous knowledge about plants and their uses. Results should be shared with local communities that have provided information to demonstrate to them the value of their cultural heritage.
- *importance of conservation and sustainable use.* Scientists should be aware of the threats to plant populations caused by over-exploitation. Plant collection and other activities should be in agreement with appropriate domestic and international laws, such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Whenever required, permits and licenses should be obtained from local authorities and from landowners if private land is involved. Education and perhaps domestication and reforestation projects are also important to promote the conservation of biological resources — the “raw materials” of our drug discovery programmes.
- *importance of basic research.* Without the rigorous application of scientific methods to isolate and test biologically active compounds, including clinical trials, knowledge of the medicinal properties of plants can be regarded as only anecdotal. In addition, the isolation of single chemical compounds is inadequate, as properties attributed to many medicinal plants could be due to a mixture of active ingredients. Potentially useful drugs may also be developed using a natural product as a key input, but by synthetically modifying its structure, a more effective or safer product can be created.
- *importance of commercialization.* The ultimate aim of research into medicinal plants should be to develop a commercial product. Ideally, basic science should reach the needs of the

people in the short term. It is also clear that science and the application of science must return benefits to the communities that provided the initial knowledge of the medicinal plant, aiding their economic development and improving their quality of life.

- *importance of knowledge-sharing.* Sharing scientific knowledge with indigenous communities has already been identified as desirable. There is also a need for scientists to share their knowledge with one another as well as with pharmaceutical companies, policy-makers and other organizations concerned with sustainable development. The creation of a network of scientists interested in all aspects of the development of pharmaceutical products from medicinal plants in the developing world will, it is hoped, assist in the exchange of scientific ideas, information, technologies and perhaps even students and other researchers. For more information about this network, contact the TWNSO secretariat at info@twnso.org.
- *need for a knowledge database.* A database of medicinal plants, including their distribution, conservation status, uses and other attributes, should be developed. Such a database should include precise geographical locations of the plant resources, which will help scientists to locate the species if re-collection is necessary. Ideally, databases should be freely available to the scientific community and the public. The creation of a historical record of community knowledge that can be shared with future generations is also desirable.

The case studies presented at the workshop — and reproduced in this volume — covered all these issues and others. Whether the research was focused on high-tech laboratory experiments involving biochemistry and molecular biology or on a clinic dispensing standardized botanical products in safe doses, there are lessons to be learned. The take-home message is that if countries in the South apply scientific principles to the development of pharmaceutical products derived from their natural plant resources, they stand to benefit not only from the improved health, and therefore productivity, of their people but also from the likely development of commercial products.

Such development, however, must be carried out in a sustainable manner with respect to both the plant resources and the by-products generated during the production process. Only science can help with these issues, highlighting the importance to developing countries of building their indigenous scientific capacity.

In summary, all our research must be addressed to promoting the role and the significance of science in promoting sustainable development.

Gloria Montenegro

Professor of Botany, Pontifical Catholic University of Chile, Santiago, Chile

Chair of the Advisory Board of the TWNSO medicinal plants project