

BIOPROSPECTING: PROS AND CONS

H.S.Sandhu

Professor-cum-Head

Department of Veterinary Pharmacology & Toxicology
College of Veterinary Science, Punjab Agricultural University
Ludhiana - 141 004, PB, INDIA

It is well known that plants are an abundant source of medicinal drugs. Today there are more than 120 distinct chemical substances derived from plants that are considered to be important drugs. Several other drugs currently available in market are simple semi-synthetic modifications of naturally occurring substances. According to an estimate, approximately 25% of the world's pharmaceutical products find a significant degree of origin in indigenous communities, which represent more than a 2000 billion dollar share in global market (Jones and Jones, 2002). Several of these medicinal products were discovered in one way or the other by the phenomenon of bioprospecting.

Bioprospecting

Bioprospecting or biodiversity prospecting is the exploration, extraction and screening of biological diversity and indigenous knowledge for commercially valuable genetic and biochemical resources. In the early stages, prospecting largely centred on the plants from the forest ecosystem. However in recent times, various other forms of biodiversity like insects, algae and microorganisms have been explored with considerable success (Kumar and Tarui, 2004). The bioprospecting of plants and living organisms for pharmaceutical purposes is useful not only to the pharmaceutical firms but also to the host country and the local people, who are benefited from the ownership of the biological resources. Although the discovery of medicinal products by bioprospecting is advantageous in several ways, the methods and applications adopted by pharmaceutical firms have been criticised at several forums. The phenomenon of bioprospecting faces a typical situation where crucial raw materials are primarily owned by the poor tropical countries, while the necessary biotechnology and R & D components are regulated by the pharmaceutical firms of the developed nations. The present discussion, therefore, mainly concentrates on the importance of bioprospecting and various problems faced by indigenous communities supplying the raw material.

Merits of Bioprospecting

1. Bioprospecting has been an important phenomenon of discovering new drugs since the dawn of civilization. Several millions of people throughout the world have been using more than 8000 species of medicinal plants for the health care needs. Over 800 medicinal plant species are currently in use by Indian herbal industry alone. In pharmaceutical industry, many well known and useful drugs have been derived from leads provided by the medicinal plants (Table 1). Even though pharmaceutical firms and scientists continue to find useful application of components from nature, their search methods and applications have changed (Kumar, 2004).

Table 1: List of some common drugs derived from plants (Taylor, 2000).

S.No.	Drug	Plant source	Action/Clinical use(s)
1.	Atropine	<i>Atropa belladonna</i>	Anticholinergic
2.	Codeine	<i>Papaver somniferum</i>	Analgesic, antitussive
3.	Cynarin	<i>Cynara scolymus</i>	Cholorectic
4.	Digitoxin/Digoxin	<i>Digitalis purpurea</i>	Cardiotonic
5.	Ephedrine	<i>Ephedra vulgaris</i>	Sympathomimetic
6.	Hyoscyamine	<i>Hyoscyamus niger</i>	Anticholinergic
7.	Methyl salicylate	<i>Gaultheria procumbens</i>	Rubefacient
8.	Morphine	<i>Papaver somniferum</i>	Analgesic
9.	Nicotine	<i>Nicotiana tabacuum</i>	Insecticide
10.	Physostigmine	<i>Physostigma venenosum</i>	Cholinesterase inhibitor
11.	Podophyllotoxin	<i>Podophyllum peltatum</i>	Anti-neoplastic
12.	Quinidine	<i>Cinchona ledgeriana</i>	Antiarrhythmic
13.	Theophylline	<i>Theobroma cacao</i>	Diuretic, vasodilator
14.	Tubocurarine	<i>Chondodendron tomentosum</i>	Skeletal muscle relaxant
15.	Vincristine	<i>Catharanthus roseus</i>	Anti-neoplastic
16.	Yohimbine	<i>Pausinystalia yohimbe</i>	Alpha- ₂ adrenoceptor blocker

2. The economic value of plants or living organisms for pharmaceutical purposes is enormous and benefiting not only to the pharmaceutical industries engaged in R & D but to host country and indigenous community also, who gain from ownership of the biological resources and expect adequate compensation for resource use, especially after the Convention on Biological Diversity (CBD) in 1992. The Convention clearly establishes the control and sovereignty of local agency over the biological resources and its diversity (Kumar and Tarui, 2004).
3. With advancement in molecular biology and availability of sophisticated diagnostic tools for screening, it has become pretty effective for pharmaceutical firms to conduct research through bioprospecting (RAFI Communique, 1994). In high-technology laboratories, extracts from biological specimens undergo rapid and precise screening procedures that allow for the isolation of chemicals displaying a specifically targeted activity. In 1980, none of the U.S. pharmaceutical industry budget was spent on research on higher plants, but, today, it is estimated that over 200 companies and research organizations world wide are screening plant and animal components for medicinal purposes.
4. Discovery of several life-saving drugs including anti-neoplastic drugs (e.g. vinblastine, taxol, topotecan and etoposide) in recent past has renewed the interest of pharmaceutical industries in bioprospecting. Efforts are being made to isolate anti-HIV drugs from natural resources. At least three anti-HIV drugs, (+) calanolide A, (-) calanolide B (costatolide) and conocurovone, isolated from plants are currently undergoing pre-clinical or early clinical trials (Taylor, 2000).

Prostratin and Homoharringtonine, the other two anti-AIDS drugs isolated from plants, are also under investigation with variable success.

5. Bioprospecting collaborations between pharmaceutical companies and countries supplying the medicinal raw material and knowledge offer not only the revenue source for under-developed countries, but also opportunities for society for better education and employment avenues. Many studies have suggested that if the bioprospecting search is based on the information and knowledge from local people, then the value of bioprospecting benefits will be higher (Martin, 2001).

Limitations of Bioprospecting

1. There is a growing concern that a number of pharmaceutical firms and biotechnology companies are exploring the forests, fields and waters of developing world in search of biological riches and indigenous knowledge with sole aim of developing patented and profitable products. Under the vast majority of cases, no money has changed hands and no recognition has been given to indigenous communities who selected, maintained and improved traditional plant varieties for medicine. Pharmaceutical firms are often accused of cheating local people by denying them access to knowledge, and financial benefits. Many pharmaceutical firms claim that the process of bioprospecting involves elements of high risk and cost and hence benefits are not significant. Therefore, most of the third world countries engaged in bioprospecting with multinational pharmaceutical firms continue their historic role of only suppliers/exporters of raw materials for accumulation of wealth in the industrialized nations.
2. The multinational companies engaged in bioprospecting are free to patent bio-materials but there are no effective guidelines and conditions defined for recognising and rewarding the contributions of indigenous people and other informal innovators who are responsible for nurturing, using and developing biodiversity. One of the enduring questions in the bioprospecting has been whether the analysis and identification of active medicinal constituent in biological samples provide the pharmaceutical firms the sole right on ecological habitat in resource rich regions or not (Zakrzewski, 2002). So the question often asked is – What gives pharmaceutical firms, the right to patent any potentially active compounds as their own discoveries, thereby preventing the legal claims of local inhabitants to royalties from the sale of such drugs regardless of their sharing knowledge with companies.
3. Although bioprospecting agreements are sanctioned by the multilateral Convention on Biological Diversity, in most cases commercial bioprospecting agreements cannot be effectively monitored or enforced by source communities, countries or by the Convention itself (Zakrzewski, 2002). In several cases, there is no regulation in place to ensure that the source countries of these plants will be adequately compensated.
4. The monetary offer by multinational pharmaceutical firms to resource countries in most cases is not sufficient. Many nations in the third world suffer from crushing burden of external debt

hence the monetary offer by multinational firms often allure them to sell off their biological resources for pittance (RAFI, 1994).

5. Several pharmaceutical firms do not bid directly for access to biodiversity, but instead, work through intermediaries (RAFI, 1994). The intermediaries may be private companies, governmental and non-profit organizations or even persons employed on contract basis. Therefore, it is often difficult for indigenous people and organizations to know precisely with whom they are negotiating or to whom they are providing their information and genetic material.
6. Imbalance in ecosystem due to excessive exploitation of material resources is always a possibility. It is a fact that the tropical rainforest regions of the world, which constitute more than 50% of medicinal plants, are disappearing (Moran, 1992). This is mainly due to multitude of commercial interests including bioprospecting.

Solutions to the Problems

Owing to the lack of proper regulation and adequate compensation for countries supplying the medicinal plant species, the questions and doubts of what can be done to bring about changes in the current system need to be addressed. Efforts should be made to sort out the differences, if any, between the pharmaceuticals firms and the countries supplying the plant materials.

1. The discoveries through bioprospecting should be equitably shared between the pharmaceutical firms and local communities and indigenous people involved in the discovery of natural products. Benefits of bioprospecting can be shared by both parties in different forms like advance payment and sharing the revenue through royalty agreements (Smith and Kumar, 2002). It is important to design a scheme where the information as well as access to the resources can be effectively shared between firms and the local people with bioprospecting site (etc group, 1994).
2. The terms and conditions of bioprospecting agreements under which indigenous people might benefit financially should be clear and transparent and free from ambiguity.
3. Training and expertise should be offered by multinational pharmaceutical companies to the natives providing raw material for drugs. Providing jobs, training and expertise to the source countries would benefit local people with opportunities to progress. Other benefits can be grants in terms of equipments and education and technology transfer.
4. The intellectual integrity of indigenous people and other rural people must be confirmed within the Biodiversity Convention. This includes the right of indigenous people to benefit from their traditions and genius and a say in all decision making forums. In absence of a convincing global ethic or clear intension on the part of the international community, indigenous communities and native governments should have every right and reason to declare a moratorium on further collecting and new agreements (etc group, 1994). The right of indigenous communities to say no to bio-pirates and to legitimate bio-prospectors must also be ensured.

5. No patenting of living products and processes should be allowed in future. Plants and living organisms should be considered the sole property of indigenous people and governments. The current intellectual properties systems do not, and will not, protect the interests of local inhabitants and informal community innovators.
6. It must be ensured in all bioprospecting agreements that a part of benefit funding goes to support environmental protection in the regions supplying the plants in order to ensure long-term stability of the natural ecosystem.

Conclusion

Despite the limitations and allegations of bio-piracy, the bioprospecting with its potential as a rich and important source of new therapeutic agents is an important tool for drug discovery and research. However, the collaborations between the pharmaceutical companies and the countries supplying the indigenous knowledge and medicinal resources should be regulated for mutually beneficial relationship.

References

1. etc group. (1994) Bioprospecting/Biopiracy and indigenous peoples : Bio-prospectors hall of shame ... or Guess who's coming to pirate your plants? Pros and cons of bilateral bioprospecting agreements. pp 1-14. November 30, 1994. <http://www.etcgroup.org>.
2. Jones, C.E. and Jones, C. (2002) Indigenous knowledge and bioprospecting. International conference. Macquarie University, Sydney, Australia, April 21-24, 2004.
3. Kumar, P. (2004) Valuation of medicinal plants for pharmaceutical uses. *Current Science*. 86 (7): 930-937.
4. Kumar, P. and Tarui, N. (2004) Identifying the contribution of indigenous knowledge in bioprospecting for effective conservation strategy. In: Bridging Scales and Epistemologies Conference, Alexandria, Egypt, March 17-20, 2004.
5. Martin, G.J. (2001) Mutual impact: The Relationship between Ethnobiological Research and the Convention on Biological Diversity, Building Bridges with Traditional Knowledge II Summit, May 28-June2, Honolulu, Hawaii.
6. Moran, K. (1992) Ethnobiology and U.S. Policy. In *Sustainable Harvest and Marketing of Rainforest Products*. Chapter 5. Plotkin, M and Famolare, L. (eds). Island Press, Washington D.C.
7. RAFI Communiqué (2006) Bioprospecting/Biopiracy and indigenous people. pp 1-13. <http://www.latinsynargy.org/bioprospecting.html>.
8. Smith, R.B.W. and Kumar, P. (2002) Royalties and benefit sharing contracts in bioprospecting. Working paper E/221/2002, Institute of Economic Growth, Delhi.
9. Taylor, L. (2000) Plant based drugs and medicines. From the Raintree Nutrition Internet Web Site. <http://www.rain.tree.com>.
10. Zakrzewski, P. A. (2002) Bioprospecting or biopiracy? The pharmaceutical industry's use of indigenous medicinal plants as a source of potential drug candidates. *Complementary & Alternative Medicine*. 29 (3): 252-254.