

REGIONAL DEVELOPMENT

Biotechnology in Mexico: Planning for the future

Mexico's rich natural resources and educational infrastructure should provide a solid base for biotechnology.

Francisco Bolívar

As the fourth richest region in the world in terms of biodiversity, Mexico is endowed with animals, plants, insects, and microbes that cannot be found anywhere else on the planet, and that, unlike petroleum (whose exploitation and commercialization have been fundamental to economic development), are renewable resources. Ecologically sound, purposeful, and effective means to use them are, therefore, perceived as having important social and economic benefits, and consequently biotechnology is now regarded as important to Mexico's development objectives.



Educational initiatives

A prerequisite to the design, not to mention the implementation, of any plan to tap Mexico's potential in biotechnology is the ability to provide the necessary human resources. Universities and other institutions of higher education in Mexico have a credible position in this regard.

Research groups in the modern biotechnologies exist at almost all universities and other centers of higher education, but there are few well-consolidated teams and only a small number of multidisciplinary and multi-institutional projects. The most advanced of these working groups are summarized in Table 1.

Four institutions offer master and doctoral programs in biotechnology, and two have master and doctoral degrees in plant biotechnology. There are also 20 master and doctoral degree programs related to biotechnology (cell biology, biochemistry, molecular biology, microbiology, etc.), and 10 institutions have master degrees related to environmental pollution treatment. These degree programs are given at the institutions mentioned in Table 1, and their study plans are based principally on

research. Very few have teaching plans that take into account the needs of industry.

Some groups, in particular at the Biotechnology Institute, UNAM, have research and technological development agreements with foreign biotechnology companies, including Schering Germany (Berlin), Berlex Laboratories (Cedar Knolls, NJ), Ciba-Geigy (Basel), Genencor (Rochester, NY), Gene-track Systems USA (Framingham, MA), and Bioeurope of France. The National Polytechnic Institute CINVESTAV working group at Irapuato also has agreements with Monsanto.

Company activities in Mexico

The development of this reservoir of human resources will depend on the requirements of Mexico's biotechnology industries. At present, these industries are almost completely reliant on technology from abroad, particularly with regard to research and development infrastructure, and exist mostly in the food industries, where they are concentrated on dairy products and yeast for bread-making and fermented beverages. These companies use fermentation and enzyme processes, and their research and development is associated to a large extent with product quality control.

An important group of biotechnology related companies that has established activities in Mexico is the chemical/pharmaceutical industry. Many of these companies are involved in antibiotic production and use large-scale fermentation and enzyme processes. Mexican firms like Cibiosa (Ramos Arizpe) are important players in the sector, but most companies are transnationals that do their fundamental research and development outside of Mexico (Pharmacia & Upjohn, Abbott Laboratories, etc.). Products such as enzymes are manufactured by firms like Enmex (Tlalnepantla), Quimorgan (Novcalpan), and Efenza (Tlalnepantla), but again their research activities are carried out by partners abroad.

Several other firms in the biotechnology

sector are involved in the production of amino acids. These include Fermentaciones Mexicana (Mexico City) and Enzymóloga (Monterrey), which produces aspartame under license from G.D. Searle (High Wycombe, UK) and has R&D activities that are related to product and/or process innovations.

In the agricultural area, important firms include Alpigen (Mexico City) and Grupo Bioquímico Mexicano, which both produce plant hormones. Two other firms—Biogenética Mexicana (Mexico City) and Génesis Integral (Mexico City)—produce plant propagation material, and Grupo Pulsar (Mexico City) and Invernamex (Mexico City) work on genetic improvement and post-harvest management. Another area, the biological treatment of waste water, is the focus for Grupo Biocontrol (Mexico City) and Atlatec (Monterrey).

Selecting strategic areas

Against this background, and in association with colleagues in academia and industry throughout Mexico, at UNAM we have sought to enumerate a core set of strategic areas (Table 2) within the agricultural, health, industrial, and pollution treatment sectors.

The following criteria were used to determine sectors: Trends and horizons in modern

Table 1. Working groups in Mexico focused on biotechnology.

Major programs
Metropolitan Autonomous University (Iztapalapa)
National Autonomous University of Mexico (Mexico City)
National Polytechnic Institute (Mexico City and Irapuato)
Other centers of expertise
National Biological Sciences School (Chapingo)
The Autonomous University of Chapingo
The Postgraduate College of Chapingo
The Scientific Research Center of Yucatán
The Autonomous University of Nuevo León
The Forestry and Agricultural Research Institute (Jivtepec)

Francisco Bolívar is research coordinator, National University of Mexico (UNAM), Mexico City (bolivar@ibt.unam.mx).

biotechnology at the international level; present capacity and potential of Mexican scientific research and technological development; identification of present and future needs

and problems in Mexico; social and economic impact of selected areas; market potential for Mexican biotechnology; vulnerability and feasibility of the areas; strategic Mexican nat-

ural resources; primary research objective in the area; capability of research to link different institutions and national efforts; capability of biotechnological development support via international technical cooperation and through financing.

Conclusions

Defining strategic areas is one thing. Exploiting them is often quite another. The structuring and implementation of an integrated plan for the development of biotechnology in Mexico will require the combined efforts of the academic, financial, industrial and governmental sectors. We must assist basic research in disciplines supporting modern biotechnology, and simultaneously encourage industry to assist in shaping multidisciplinary projects at the postgraduate level within the universities. This participation of existing Mexican industry in research and development projects in biotechnology is fundamental and must be stimulated. Without these cooperating elements, there is little chance of Mexico becoming even a minor player on the stage of international biotechnology. With them, there is little doubt that it can make an important contribution. ///

Table 2. Strategic areas in biotechnology for development in Mexico.

Area	Objectives
Agricultural sector	
Plants	Increase productivity/quality of agricultural products Decrease time and cost of plant breeding Development of biopesticides and biological control Assessment, use, and rational, respectful conservation of genetic diversity Plants as genetic models Plant virology
Livestock	Increase productivity and quality of meat and milk using recombinant hormones Production of high-value proteins from transgenics Production of new vaccines and intracellular immunization Generation of diagnostic methods and systems Transgenic animals as human disease models
Health sector	Production of proteins of therapeutic interest Vaccine development and production. Development and production of diagnosis systems Design, production and methods for drug administration Molecular biology of the human genome. Molecular medicine
Industrial sector	Isolation and genetic modification of microorganisms of industrial interest Design and overproduction of enzymes with special properties Process development and optimization.
Pollution treatment sector	Anaerobic treatment of waste water Bioremediation



The Secret Garden

The Garden of England holds many secrets. Almost unseen, there are youthful and vigorous technology companies sprouting and growing amidst the established universities and incomparable infrastructure of Kent.

Perhaps one of the best kept secrets is Sittingbourne Research Centre. The former home of Shell Research, this is a very rare specimen. Laboratories, specialist science buildings, offices, leisure facilities and 24 hour security make this a unique and fertile environment. What's more, Kent offers, quality workforce quality lifestyle and clear pathways to Europe.

If you are hoping to grow an existing company or new venture then speak to Sheila Marshall.

Tel: 01795 411500 for a full information pack.

Premises for new and emerging science companies for lease
 Sittingbourne Research Centre, Telephone: +44 (0) 1795 411500, Fax: +44 (0) 1795 411511
 E-mail: src@src-uk.com, Internet: <http://www.src-uk.com>

