BIOTECHNOLOGY IN BRAZIL

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Brief Introduction to LORRE

**Distinguished Professor and Director**: Dr. Michael Ladisch

- Established in 1978 to carry out research on transforming renewable resources to liquid fuels.

- The role of the Laboratory in multidisciplinary research evolved over its 31-year history from biofuels research to its current function as an Integrative Center for Biotechnology and Engineering which carries out multi-disciplinary research in:

  **Bioenergy, Bioprocessing, Bioproducts, Bionanotechnology and Biorecovery**
LORRE has capabilities ranging from fundamental studies on the molecular genetics of yeast and bacteria to bioreaction and bioprocess engineering, and biotechnology that uses organisms, tissues, cells, or their molecular components to:

1- act on living things,
2- intervene in the workings of cells, including their genetic material,
3- provide templates for advanced non-living systems that emulate specific biological functions, and
4- manufacture bioproducts.
BRAZIL: SOME GENERAL INFORMATION

The Federation: Federal District, 26 States and 5,564 Municipalities

Climate: mainly Tropical; however more than 60 percent of the population live in areas which are cooled either by altitude, sea winds or polar fronts.
It is the **fifth largest** country by geographical area (8,514,877 km$^2$), occupying nearly **half** of South America.
- Colony of Portugal from 1500 to 1822;
- Official Language: Portuguese;
- Population: 191,241,714 (estimated for 2009), being the fifth most populous country in the world;
- Capital: Brasília (planned and developed in 1956, and becoming official capital in 1960)
BRAZIL: SOME GENERAL INFORMATION

- Ethnic groups: multiethinic society

49.7% white  
42.6% Pardo  
6.9% Black  
0.5% Asian  
0.3% Amerindian

Influence from different cultures

Native
Portuguese
African
Spanish
Italian
German
Dutch
Japanese
In according to International Monetary Fund and World Bank:

- Brazil is the **largest** national economy in Latin America;
- the world’s **tenth** largest economy at market exchange rates
- **Currency**: Real

Brazil is a **major** producer of:

Soybeans, Cotton, sugar, cocoa, coffee, frozen concentrated orange juice, beef, poultry, pork, tobacco, fruits and nuts, fish products, and wood products

2006 : United States-Brazil bilateral agricultural trade : record of US$ 4.2 billion

Record Brazilian exports to the United States : US$ 3.9 billion
February 2007:

President Luiz Inacio Lula da Silva signed a decree creating the National Committee for Biotechnology and outlined a national policy for the sector.

- Invest 10 billion reais (~ US$ 5 Billion) in biotechnology over 10 years
- Government contribution: 60%
- The other part: provided by the private sector
- Channeled into 4 areas: health, agriculture, industry and environment
- Brazil is the home of one fifth of the world biodiversity.

**Amazon:**

- Largest forest area in the world:
- 1,5 million people live in the forest
- 20% of planet’s drinking water
- 3,000 fish species
- 5,000 species trees
- 1.5 million catalogued plant species
- 950 types of birds
**Problems faced in the Amazonian region:**

Past decades: disorderly occupied by the agricultural frontier, followed by high environmental destruction rates and low social and economic return.

**Environment control** needed in regard to: deforestation, forest fires, illegal traffic of wild animals and biopiracy.

Cattle ranching major driver of deforestation in the Brazilian Amazon.
AMAZONIAN REGION: NEW NASA RESEARCH REPORT

Sharp decline in the amount of smoke over the Amazon during the 2008 burning season

Coinciding with a drop in deforestation reported by Carlos Minc, Brazil's Environment Minister

President Luiz Inacio Lula da Silva recently committed the country to REDUCE ANNUAL FOREST LOSS 70% BY 2018 under its national climate action plan. Lula expects industrialized countries to help fund the conservation initiative, which would avoid some 4.8 billion tons of carbon dioxide emissions.
Some other measures (07/2008):

The government has responded to Greenpeace's report: on the day that *Slaughtering the Amazon* was released, a Brazilian federal prosecutor filed a billion dollar law suit against the cattle industry for environmental damage. Firms that market tainted meat may be subject to fines of 500 reais ($260) per kilo.
Biotechnology companies in Brazil: as identified in the report Brazil “Biotechnolog Industry” (Massachusetts Office of International Trade & Investment, report prepared by Massachusetts South America Office: www.massbrazil.com.br)

Identified following the definition: “Biotechnology companies are those whose main commercial activity depends on the application of biological organisms, biological systems or biological processes, either as internal research and development, in manufacturing or in the provision of specialist services”
Life Sciences x Biotech Companies:

Examples of Life Sciences Companies:

Companies with activities in human and animal health, agriculture and environment, but that do not fit the previously mentioned adopted definition for biotech companies;

Some examples: Companies that conducts pre-clinical and clinical trials, that commercialize but do not develop diagnostic kits or laboratory equipment

Therefore: for this report “all biotechnology companies are also life sciences Companies, but not all life sciences companies are biotechnology companies”
MAP 1 – GEOGRAPHICAL DISTRIBUTION OF LIFE SCIENCE COMPANIES BY STATE(%)
In conclusion the geographical distribution of Brazilian life science and biotechnology companies is very similar (Chart 2).
CHART 1 - BIOTECHNOLOGY COMPANIES AMONG THE LIFE SCIENCES GROUP (%)*

*The green sector (Others) represents the group of companies, among the life sciences, that were not classified as biotechnology.

Source: BIOMINAS Foundation (2007)
On March 21, 2007 Brazil’s President signed Law number 11,460:

Which alters provisions of the Biotech Law 11,105 from 2005

Main change: reduction in the number of votes to approve individual biotech events by the National Technical Commission on Biosafety (CTNBio)

Purpose: speed approval process of new biotech events, which has been blocked by anti-biotech groups

However, it is still a complicated process subject to court injunctions
The Brazilian Health Biotech Sector: addressing the needs of the country vast population for sustainable and affordable health products.

Recent years → Increased emphasis on the role of the private sector as a mean of complementing public-sector efforts in accelerating health product innovation and provision.

Market for health products: significant over recent years. Generic medicines leading the way.

Brazil’s domestic health biotech sector: dominated by few generic domestic manufacturers.
BIOTECHNOLOGY IN BRAZIL

Products and Services: Several companies are increasingly focusing on innovative diagnostics or drugs products affordable and easy to use.

Few of those companies report exporting products outside Brazil to any significance.

Main types of products and services under development in the Brazilian health sector: vaccines, diagnostics and reagents, therapeutics and services.
Vaccines (primary suppliers): two government owned vaccine manufacturers

Supply of affordable vaccines: vaccination of ~100% of population for most routine vaccines

Butantan Institute (São Paulo): 80% of the domestic human vaccine antigens in Brazil

Immunobiologicals Technology Institute (Rio de Janeiro)

Modified Diphtheria-pertussis-tetanus vaccine

Recombinant hepatitis B virus surface antigen vaccine

Inactivated rabies vaccine

Yellow fever and Bacille Calmette Guérin (BCG) vaccines
**Reagents and Diagnostics**: production of a host of monoclonal antibodies for various diagnostic tests, some companies providing diagnostic kits suited for small laboratories and rural settings:

- Developing a TB test using PCR technology (6 X cheaper than the actual available products: in 2005 there was 140,000 cases of TB);

- Development of a test for Chagas disease that can be read by ELISA readers (more common in Brazil than luminometers which are used by the original test)
**Therapeutics**: many private companies have developed, or are developing innovative therapeutics:

- Anti-inflammatory *Achefan*: natural product extracted from the plant *Cordia curassavica*;
- *BIOCURE*: natural latex membrane derived from the plant *Havea brasiliensis* containing vascular growth factor (VEGF) for the treatment of skin lesions (diabetic ulcers, surgical wounds);
- *Dermacerium*: a formulation of cerium nitrate and silver sulfadiazine, used for treatment of burns and other skin lesions
In according to Rezaie et al. 2008:

Now that strong scientific foundation has been laid, it is needed: a sustained focus on effective policies and their implementation, together with enhanced organizational competence; and the facilitation of interactions among the various components involved.

These actions can help Brazil replicate in health biotech its considerable success in other areas, such as aviation and deep-sea drilling.

THE BRAZILIAN BIOFUELS INDUSTRY

Ethanol: not used in significant amounts until the mid 1970s

Dramatic increase in the cost of oil at the time of the first oil crisis

Severe impact on countries dependent upon oil imports, including Brazil

Brazil: leader producer of sugar from sugarcane

Well situated to explore the option of ethanol as an alternative to gasoline

Redirection of sugarcane production to generate ethanol as replacement for gasoline, reducing oil imports
Under the **Brazilian Government’s plan**:

- **PETROBRÁS** (state-owned) oil company: would purchase a guaranteed amount of Ethanol from producers;

- Economic incentives were given to agro-industrial enterprises willing to produce ethanol in the form of **low interest rates**

  = translated into nearly U$ 2.0 billion in loans from 1980 to 1985, representing **29% of the total investment needed**.

  ↓

Ethanol production increased rapidly over the years, reaching **18 billions liters** in 2007.
Ethanol in Brazil initially used in 2 ways:

1- **blended as an octane enhancer** in gasoline; typical blends range from 20 to 25% anhydrous and 0.4% water;

2- **or its own**, in neat-ethanol engines; used in the form of hydrous ethanol at 95.5 Gay Lussaca (GL)

2003: Introduction of **flex-fuel motors** in Brazil capable of running with blends from E10 to E100

Technology based on **sensors** in the fuel system that automatically recognizes the ethanol level in the fuel.
Present “status” of the ethanol program in Brazil:

- 325 plants in operation crushing 425 million tons of sugarcane per year:

  One half used for sugar
  
  One half used for ethanol production

- 17.8 billion liters of ethanol were produced in 2006 using 2.9 million hectares of land;

- Most of the large plants are located in Sao Paulo (almost two thirds of the ethanol production)
THE BRAZILIAN BIOFUELS INDUSTRY

Amazon forest

Sugar cane cultures

- The production of ethanol from sugarcane is much cheaper than that from other crops such as corn, wheat and sugarbeet.

- Presently: gasoline used in Brazil is blended with 25% anhydrous ethanol;

- Drastic reduction in CO emissions:

- Before the Alcohol Program in Brazil: In São Paulo CO emissions were higher than 50g/Km driven, and it was reduced to less than 5.8 g/km in 1995;

- The positive energy balance associated with sugarcane based ethanol is reflected by a considerable reduction (91%) in greenhouse gas emissions resulting from replacing gasoline with this biofuel.
Future Perspectives:

- Efficiency can be increased through improvements in the agricultural and industrial phases of the production processes.

- In Sao Paulo: an increase of 12% in sugar cane yield is expected over the next 10 years. Combining with expected 6.2% improvement in fermentation efficiency and 2% in sugar extraction, ethanol yields may increase by 29%.

- Also there is perspective for the production of large amounts of electricity from the burning of bagasse with improved technologies: use of high pressure boilers operating at close to 100 bar units (in contrast to the low-pressure, 20 bars units used in the past).
Dr José Goldemberg: has received the annual Blue Planet Prize (2008) from Japan’s Asahi Glass Foundation for ‘making major contributions in formulating and implementing many policies associated with improvements in energy use and conservation’.

He is one of the pioneers behind the development of Brazil’s sugarcane-ethanol programme, which has led to the country becoming a major producer and exporter of this form of biofuel, and to 90% of its new cars being able to run on any mixture of ethanol and petrol.

In the book Energy for a Sustainable World (1988) he argued that “developing countries did not need to follow the energy path of industrialized nations but could instead ‘leap-frog’ them by using cleaner technologies such as fuel alcohol”.

THE BRAZILIAN BIOFUELS INDUSTRY

The Fulbright Commission for Educational Exchange between Brazil and the United States of America seeks to establish thematic network with the participation of Brazilian and U.S. researchers and scientific institutions. The Networks aims at contributing to communication improvement between higher education and scientific institutions from both countries that lead research projects in the area of Biofuels.

Project Goals:

- Promote awareness of selected research activities on biofuels programmed and going on in a variety of U.S. and Brazilian institutions;

- Improve the communication between researchers and faculties from various institutions in Brazil and in the U.S.;

- To encourage the development and advancement of joint student exchange and research projects, technologies and production of scientific evidence between Brazilian and U.S. counterparts.

http://www.brazil-usa-network.org/biofuels
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THANKS !