Forma correcta de citar este articulo: HERMANN GONÇALVES SCHATZMAYR and MARILIA BERNARDES MARQUES 1994. INDUSTRIAL BIOTECHNOLOGY IN PUBLIC HEALTH: PERSPECTIVES FOR LATIN AMERICA AND THE CARIBBEAN. INTERCIENCIA 19(1): 7-13. URL: http://www.interciencia.org.ve

INDUSTRIAL BIOTECHNOLOGY IN PUBLIC HEALTH: PERSPECTIVES FOR LATIN AMERICA AND THE CARIBBEAN

HERMANN GONÇALVES SCHATZMAYR and MARILIA BERNARDES MARQUES

Hermann Gonçalves Schatzmayr, Ph.D. Former President of Oswaldo Cruz Foundation (1990-1992); Chief of the Department of Virology of Oswaldo Cruz Foundation: Member of the Steering Committee of the Children's Vaccine Initiative, CVI Address: Fundação Oswaldo Cruz, Av. Brasil, 436, Manguihnos, Rio de Janeiro, Brazil. Marília Bernardes Marques, M.D., Ph.D. Professor and Researcher of Oswaldo Cruz Foundation since 1977 and Coordinator of the Committee of Science and Technology of the National Health Council of Brazil.

SUMMARY

This paper analyzes, by outlining public perspectives, the current industrial biotechnological capacity of Latin America and the Caribbean to develop regional programs for therapeutic drugs, vaccines and diagnostic products. After discussing perspectives of and constraints on the development of modern industrial biotechnology, the paper concludes by suggesting that, in the face of growing privatization, international negotiations should be redirected. Otherwise, biotechnology will never be a primary resource in the developing world especially in Latin America and the Caribbean. KEY WORDS / Biotechnology in Public Health / Biotechnology-based products / Latin America / Caribbean /

As we near the end A this century, it is widely recognized at the international level that both perspectives of and existing constraints on the development of modern industrial biotechnology an located primarily in advanced industrialized nations while the performance of Latin American and Caribbean countries remains marginal (Dembo, Dias and Morehouse, 1989; Goldstein, 1991).

Public health applications of current and potential biotechnology are mainly located in the chemical-pharmaceutical sector and are influenced by important conditioning factors: new therapeutic and diagnostic products, of high aggregate value are developed to meet the demands of the industrial nations (Correa, 1991).

Notwithstanding this trend, potential applications of these new biotechnological tools are promising for endemic and epidemic Latin American and Caribbean countries' infectious and parasitic diseases including leishmaniasis, dengue fever and Chagas disease. Vaccines against tropical diseases for human and animal use can already be produced by genetic engineering. Other than tropical and parasitic diseases, chronic and acute infectious respiratory diseases, such as pneumonia caused by *Streptococcus pnenumoniae* and *Haemophilus influenza* type b bacteria and by parainfluenza and respiratory syncytial viruses, as well as diarrheas diseases caused by rotavirus and by shigella, *Vibrio cholerae* and certain types of *Escherichia coli* bacteria (Robbins *et al,* 1988) also deserve mention. These infectious diseases are responsible for high morbidity and mortality rates in Latin American and Caribbean countries and effective vaccines for these diseases are highly desirable for this region.

At the international level, the industrial biotechnological structure is generally integrated by highly specialized small and medium sized private firms, and by the largest enterprises in the petrochemical, chemical, pharmaceutical and food sectors. In Latin America and the Caribbean multinational corporations dominate these industrial sectors but local R&D investment in modern biotechnology is quite small. Still, these companies manifest a deep interest in their national markets. Consequently, a current trend at the regional level is the growing privatization of industrial

biotechnology. This trend is more evident in the industrialized countries, particularly the United States, the leading nation in new biotechnology.

This paper focuses on the current capacity of Latin America and the Caribbean in industrial biotechnology as applied to human health by outlining public perspectives - that is, the development of regional programs for therapeutic drugs, vaccines and diagnostic products.

Regional Efforts After 1980 and Current Capacity

Since the 80s, despite economic adversities and thanks to justified expectations in modern biotechnology, these countries introduced specific initiatives and rational health governmental programs: Mexico, Costa Rica, Cuba, Venezuela, Colombia, Chile, Uruguay, Argentina and Brazil (Correa, 1992; Commandeur, 1993). Their initiatives and programs allowed the development of links between university research activities and demands of industry and service. According to Commandeur (1993):

"The creation of national biotechnology programs was a first step in defining policies for the development of (modern) biotechnology capabilities in almost all Latin American countries. With these programs, governments aimed to coordinate R&D institutions and projects, to stimulate link-ages to industry, to channel international cooperation and, in some cases to finance projects".

A number of experiments in modern biotechnology are now proceeding in Mexico, Argentina and Brazil, but with few industrial plants designed by engineers working at the universities and transferred later to the private sector. A successful example of this is the science park located in Rio de Janeiro for the development of R&D in biotechnology (the BIO-RIO). This science park receives financial support from industry, federal and local governments, and involves diverse academic research laboratories at the Federal University of Rio de Janeiro (UFRJ) and the Oswaldo Cruz Foundation (FIOCRUZ).

Despite limited regional investment, a reasonable number of academic laboratories are now locally producing some necessary products that, until recently, were imported at high costs. While Brazil has already developed some local production of restrictive enzymes, marked nucleotides and tissue culture media, Mexico dominates the technical process of oligonucleotide synthesis, Colombia produces Petri's plates and in Argentina refrigerators, including 70c cameras are manufactured at a lower cost than those similar to ones imported (Orrego, 1987). Other products and services that are now available such as plasmides, monoclonal antibodies synthesis and immunodiagnosis assays can also be transferred to small regional firms for production.

In the 1987 study prepared for the Organization of American States (OAS) Orrego pointed out that at least sixteen international Organizations were active in the development of biotechnology in Latin America and the Caribbean. Among diverse initiatives, those that are noteworthy include: the Tropical Diseases Program (TDR-WHO); the United Nations Development Program (UNDP) Me United Nations Industrial Development Organization (UNIDO) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) launched in 1986, a US$ 5 million program: the Regional Biotechnology Program for Latin America and the Caribbean, focused on R&D up to laboratory level, on the improvement of education in basic -sciences, and the detection and evaluation of suitable technologies and their further development in pilot schemes for industrial application. National biotechnology commissions were appointed to coordinate the activities in each one of the 13 participating countries and in 1992, a new phase of this program started.

TABLE I CURRENT CAPACITY OF BIOTECHNOLOGY APPLIED TO PUBLIC HEALTH: T HE SOUTH CONE GROUP

Country	*Current Capacity (Public and Private)*
Brazil	

	1. Serum and Vaccines (industrial facilities are exclusively governmental): Oswaldo Cruz Foundation (FIOCRUZ) - Rio de Janeiro Vital Brazil Institute - Rio de Janeiro Ataulpho de Paiva Foundation - Rio de Janeiro Butantan Institute - São Paulo Institute of Biological Research - Rio Grande do Sul Ezequiel Dias Foundation - Minas Gerais Parana Institute of Technology - Parana
	• Diagnostic Products:
	2.1. Public Producing Centers: Oswaldo Cruz Foundation - Rio de Janeiro, Minas Gerais, Bahia, Pernambuco Adolfo Lutz Institute - São Paulo Institute of Biological Science/.Federal University of Minas Gerais (UFMG) São Paulo School of Medicine/ Department of Microbiology Evandro Chagas Institute - Para Institute of Tropical Medicine/São Paulo University (USP) Federal University of Rio de Janeiro (UFRJ) Federal University of Bahia (UFBa) Ludwig Institute - São Paulo
	2.2. Industry: in the 80's the number of firms increased rapidly and according to be data of the Brazilian Association of Enterprises (ABRABI) sixty out of 234 enterprises working with modern biotechnology, representing nearly 25%, are involved in human health, most of them new small-sized firms.
Uruguay (*)	
	1. Santa Elena Laboratory S/A - To become the Uruguaian Enterprises of Biotechnology S/A to produce vaccines rising recombinant DNA techniques. 2. University of Uruguay. 3. "Clemente Estable" Institute of Biological Researches.
Argentina (*)	
	There are already some pharmaceutical products in the market produced with genetic engineering techniques such as human interpheron alfa 2 and human erytropoietin; there are firms with their own R&D teams, as well as technology transfer agreements with the academic sector. Vaccines are produced exclusively by the government. Some enterprises are incorporating modem technologies for immunological diagnostic tests and also as detectors for genetic material originating from pathogenous agents.

Sources: (*) UNDP/Bío-Río La Botecnología Industrial en America Latina y el Caribe. Bernardo Sorj (org.). Rio de Janeiro, 1990, 124 p.
Sources: (**) FUNDAÇAO Oswaldo Cruz Biotecnología em Saúde no Brasil. Limitações e Perpectivas. Serie Política de Saúde Nº 3, Rio de Janeiro, março 1987. 92 p.

TABLE II CURRENT CAPACITY OF BIOTECHNOLOGY APPLIED TO PUBLIC HEALTH: COSTA RICA, MEXICO AND CUBA

Country	Current Capacity (Public and Private)

Costa Rica (*)	
	1. Costa Rica Institute of Research and Teaching in Health and Nutrition (INCIENSA). 2. Clodomiro Picado Institute (UCR). 3. Research Center in Celular and Molecular Biology. 4. EXOT/IMPEX S/A (enterprise). 5. University of Costa Rica.
Mexico (*)	
	1. Industry: five enterprises are involved with modern biotechnology applied to human health and two enterprises are producers of vaccines for human use. 2. Research Centers: Institute of Biomedical Research-Autonomous National University of Mexico (UNAM). Institute of Biotechnology - UNAM. Faculty of Medicine - UNAM. Institute of Celular Physiology - UNAM. National School of Biological Sciences - IPN. National Laboratories for Industrial Development. State of Jalisco Center for Research and Technical Assistence. National Institutes of Health. Center for Advanced Research and Studies.
Cuba (*)	Center of Genetic Engineering and Biotechnology - established in 1986 as a complex conceived to join in the same plant all modern biotechnology.

Sources: (*)UNDP/Bío-Río La Biotecnologia Industrial en América Latina y el Caribe. Bernardo Sorj (org.). Rio de Janeiro, 1990. 124 p.
Sources: (**) Catalogues and Leaflets of the Center of Genetic Engineering and Biotechnology.

The Regional Program for the Development of Biotechnology (Reference is missing) Applied to Health (PAHO), at an estimated cost of US$ 25 million, expected not only to strengthen the existing facilities but also to raise the current capacity of industrial scale production of biomedical products and to articulate efforts to cooperate and complement activities initially in six countries - Argentina, Brazil, Costa Rica, Cuba, Mexico and Venezuela. (Personal information, 26th Meeting of PAHO's Advisory Committee for Health Research, Rio de Janeiro, August 3-7, 1987).

Studies have been undertaken by PAHO (1991) towards establishing a multinational and multiinstitutional Regional System for Vaccines (SIREVA) aimed at an approach that would integrate R&D, industrial production, as well as (human resources) training and teaching activities. This approach will be introduced to strengthen current capacity and to facilitate the technological transfer of modern biotechnology.

To these programs should be added efforts to integrate regional and national initiatives: in 1986, an agreement between Venezuela and Colombia was established; in 1985, the Brazil/ Argentina Center for Biotechnology (CABBIO) was established and, thus, made possible numerous partnership experiences involving public research institutions and private firms, The CABBIO program funds were US$ 20 million for the first 5 years, and according to Commandeur (1993), they were partly the first direct subsidies for private biotechnology R&D in both countries.

A new initiative, dating from 1992 is the Bolívar Program for Regional Technological Integration, Innovation and Industrial Competitiveness. This program has national offices and converges with an initiative of the Interamerican Development Bank (IDB) and aims at the establishment of joint ventures between enterprises and research centers of two or more countries, at achieving homogeneous international quality standards, and at the strengthening of the productive capacity of each country by generating new products, processes and services (Commandeur, 1993).

The European Community (EC) and the Latin American Economic System (SELA) finalized in 1992 the proposal of a joint program intended to cover a period of at least 4 years, and aimed at the creation of biotechnology trade between Europe and Latin America.

Tables I, II and III present R&D and current industrial production capacity of the private and public sectors involved in biotechnological applications to public health in Latin America and the Caribbean.

Perspectives

Therapeutic Products

There have already been several important attempts to achieve local production of biotechnology-based pharmaceuticals such as insulin, interpherons and interleukines. Besides these substances, the purification and synthesis of other biotechnological health care products such as aminoacids, nucleotides, steroids, enzymes and hormones are also being pursued.

Nevertheless, from the point of view of the General Director of The Regional Biotechnology Program (UNIDO/ UNESCO/ UNDP) Rodolfo Quintero (1991), Latin America and the Caribbean are already external to the market of therapeutic products obtained through biotechnology. This market will be in the volume of hundreds of billions of dollars by the end of the 90s, when approximately three hundred new active principles resulting from research in these areas are projected to be in the market. The market of health biotechnology is estimated to be around 100-150 billion dollars by year 2000. New therapeutic proteins will be between 110-150.

To confirm this pessimistic opinion from the perspective of regional development of therapeutic products, Quintero emphasizes the wide R&D lag between industrial investments and governmental expenditures in some European countries, the United Sates and Japan compared to similar expenditures in Latin America and the Caribbean as a whole: while only the United States government announced a 1992 budget that attained the huge amount *of US$ 3.6* billion in this sector, the total for regional investments are much smaller, even when considering the sum of the most important expenditures: Cuba's antimeningococcical vaccines and interpheron; the Brazilian human insulin produced by Biobras; Argentina's production of interpheron, EPO, recombinant-Hu-IFN, and interleukine by Biosidus.

Despite the almost unsurmountable existing obstacles, local analysts suggest that entrepreneurial and political commitment, qualified staff, and appropriate financial banking, may permit some Latin American countries entry into the biopharmaceutical field (Correa, 1991, p. 54).

Vaccines

Investments in vaccines deserve a distinct approach not only for their commercial relevance but also because they constitute a strategic niche in public health. The developed nations are focusing their major interests only en seventeen out of twenty-six currently existing priority vaccines for Latin America and the Caribbean.

According to Robbins & Freeman (1988) the main obstacles to the development of vaccines in Asian, African, Latin American and Caribbean countries are due less to lack of scientific capacity than to economic and political reasons: the largest companies own the technology and the industrial facilities to manufacture vaccines but are located in the developed countries. For these firms, commercial interest in vaccines for prevention of infectious diseases that are especially relevant to Third World children is rather low.

The central point is, therefore, how to make available vaccines not marketable in the First World. Robbins and Freeman give examples of vaccines that, although scientifically viable, are neglected by large pharmaceutical companies. They include: vaccines against shigellosis, leprosy, *Streptococcus pneumonia* infectious diseases, enterotoxic *Escherichia* coli; this same lack of interest will probably decrease the availability of improved vaccines against measles, poliomyelitis, cholera, typhoid and yellow fever.

To sum up, the driving forces of the international market do not support large scale local production of vaccines which are of great importance to Latin America and the Caribbean.

The solution to this dilemma should come from local governmental initiatives directed at improving current standards of productivity and quality in the manufacture of regional industrial vaccines. one central issue is how to choose (or implement) strategies that attain technology transfers from developed nations, a challenge that should bring together international agencies and governments of South American countries.

A mechanism to be expanded in the region is the transfer of technology between governmental institutions from developed to developing countries which is considered a very feasible approach, already tested and implemented. A good example is the state Institute for Public Health and Hygiene, Bilthoven, Holland, and their projects on vaccine production with Egypt and China.

One advantage is the existence of a traditional technological and industrial capacity for vaccine production, mainly by public Latin American institutions, as shown in Tables I, II and III.

Nevertheless, availability of high quality vaccines is limited and locally-produced ones are more expensive than those imported. Mexico is the only country in Latin and Central America with the industrial production capacity to meet WHO's Expanded Program on Immunization (EPI), fulfilling 60% of its total national requirement. Despite capacities produced by some South American countries, less than 50% of their total requirements are supplied by local production. In Central America and the Caribbean - save for Cuba -there is no industrial production of vaccines (PAHO, 1990).

Table IV presented by PAHO shows the countries producing bacterial vaccines in Latin America.

TABLE III CURRENT CAPACITY OF BIOTECHNOLOGY APPLIED TO PUBLIC HEALTH: ANDEAN GROUP

Country	*Current Capacity (Public and Private)*
Venezuela	
	1. QUI-BIOTE-C (enterprise connected with the Venezuelan Institute of Scientific Researches). 2. National Institute of Biomedicine. 3. Amazonic Center for Research and Control of Tropical Diseases.
Chile	
	• Catholic University of Chile. • University of Chile.
Colombia	
	• San Juan Dias Hospital Institute of Immunology. • University of Colombia. • National Institutes of Health.

	• University of del Valle.
Perú	
	1. Institute of Tropical Medicine. 2. San Marcos University. 3. Cayetano Heredia.
Bolivia	
	• Institute of Biology.
Ecuador	
	• Two units being set up for production of monoclonal antibodies to use for diagnoses (malaria).

Sources: (*)UNDP/Bío-Río La Biotecnología Industrial en América Latina y el Caribe. Bernardo Sorj (org.), Rio de. Janeiro, 1990, 124 p.

TABLE IV BACTERIAL VACCINE PRODUCING COUNTRIES IN LATIN AMERICA ACCORDING TO VACCINE TYPE, 1984

Vaccine	*Type*	*Country*	*Strain*
BCG	Liofilization Liquid	Argentina	Park 1173
		Brazil	Moreau
		Cuba	Moreau
		Mexico	Copenhagen 1331
		Ecuador	Gothenburg
		Uruguay	Paris 1173
DPT	Submerged Cultivation	Brazil	
		Chile	
		Mexico	
		Venezuela	
DT	Conventional Methods	Argentina	
		Brazil	
		Colombia	
		Cuba	

		Chile	
		Ecuador	
		Venezuela	
TETANIC	Submerged	Brazil	
TOXOID	Cultivation	Mexico	

Source: Pan American Health Organization. Las Condiciones de Salud en las Américas. Washington, D. C., Publicación Científica Nº 524, vol. 1: 303. 1990.

TABLE V VIRUS VACCINES PRODUCING COUNTRIES IN LATIN AMERICA ACCORDING TO VACCINE TYPE, 1989

Vaccine	*Country* (a)	*Strain*	*Annual Production* (b)
Against Poliomyelitis (oral)	Brazil	Sabin	only bottled (c)
Serumtypes I, II, III	Mexico	Sabin	10-12
Against Measles	Brazil	CAM-7	9
	Mexico	Edmonston- Zagreb	6
Against Yellow Fever	Brazil	170	-

(a) National Institute of Virology. General Management of Biological and Reagents Products in Mexico and Bio-Manguinhos/FIOCRUZ in Brazil.
(b) Millions of doses.
(c) Bottled bulk of the vaccine purchased in the international market.
Source:Pan American Health Organization. Las Condiciones de Salud en las Américas. Washington, D. C., Publicación Científica Nº 524, vol. I: 303, 1990.

In 1989 the EPI's supply of virus vaccines were produced only in two Latin American countries: Brazil and Mexico. Both these countries are measles-vaccine producers but only Mexico produces oral vaccines against poliomyelitis, while Brazil bottles vaccines imported in bulk from Europe. Still, Brazil is the only country in Latin America with industrial capacity to produce the vaccine against yellow fever approved by WHO (Table V).

Table VI shows an estimate of the requirements for Latin America and the Caribbean in 1990 and the production capacity in the same year, for WHO's EPI virus and bacterial vaccines.

According to Quintero (1991), the R&D cost of vaccines, encompassing five to fifteen years, range from US$ 15 to $ 30 million.

Table VII enables us to evaluate Latin American and Caribbean potential for developing vaccines aimed at preventing and controlling indigenous infectious diseases. PAHO's data (1991) shows seven countries in the region that participated in eighteen studies directed at developing thirteen vaccines, four of which are already in use; PAHO points out that in six of these eighteen studies the involvement of Latin American laboratories was decisive in identifying the immunoprotector antigen (rabies-CRL, B hepatitis, B meningococcus) as well as producing promising antigens (leprosy and malaria).

If, therefore, political policy-makers decide to establish priorities for industrial production of vaccines

and to further scientific and technological development it will be necessary to introduce joint projects, with the involvement of several governments, regional and international agencies. Only then will it be technically possible to achieve self-sufficiency in our quest for health goals without competing in commercial international markets.

Diagnostic Products

Besides those already mentioned, new and better diagnostic products will be produced with the application of modern biotechnology resources, through the use of antigens and monoclonal antibodies that increase the sensitivity and precision of diverse assays which are applied in infectious and parasitic diseases.

But, in the diagnostic products segment, an analysis of perspectives should include commercial aspects because there is opportunity for institutional research and for production of kits for clinical diagnosis based on modern biotechnology (monoclonal antibodies and recombinant (DNA) which are already being carried out in this region.

The limited and precarious situation of current Latin American and Caribbean networks of laboratories make technological simplification of serological diagnosis procedures an urgent solution to overcome present obstacles to complete utilization in priority health care programs as well as in epidemiological monitoring.

Recent advances in the development of diagnostic methods using gene amplification techniques and nucleic acid hybridization will make possible new strategic clinical and epidemiological approaches by introducing simpler, faster diagnostic tests which will be safer, sensitive and more specific. An example is the possibility of the substitution of the current xenodiagnosis technique in Chagas disease for the polymerase chain reaction technique (PCR).

The nucleic acid amplification technique, not yet available in kits approved by the American Food and Drug Administration (FDA) provide a potential application for regional endemic and epidemic diseases.

The bottlenecks that occur in large scale production do not apply to the manufacturing of these products. In the development of this area of industrial biotechnology a special type of symbiotic relationship takes place between large corporations in the chemical-pharmaceutical sector and the so-called new biotechnology firms (NBFs): strategic alliances or partnership.

By making use of current facilitating programs of regional and international agencies for development such as PAHO, UNIDO, OAS, IDB, EC and SELA, strategic alliances between universities and research institutions of the region and private firms of the northern hemisphere might also provide viable means for agreement or joint ventures. These alliances would make North-South technology transfers possible.

The current existing scientific and technological capacity of Latin America and the Caribbean countries represents a comparative advantage to compete in the niche of diagnostic products, the regional drawback being the marketing stage. This drawback can, however, be overcome with the introduction of the strategic commercial alliances that could be established with the United States, Europe and Japan NBFs. These partnerships will make possible, besides being access to new biotechnology, the development of technology assessment capacities necessary to deal with safety, efficacy and efficiency criteria, especially those adopted by the FDA.

Conclusion

After the examination of the Latin American and the Caribbean situation we can conclude by pointing out that modern industrial biotechnology applied to public health problems is in is beginning stage. The strengthening of scientific and technological capacity in the region is an urgent requirement because these modern tools offer special opportunities both to increase present health standards and o introduce procedures including low cost techniques in the national health-care system.

A number of constraints of diverse natures also have an effect on their modest advances and should be considered in analysis of public perspectives of industrial biotechnology: on the market level, low income standards presented by local consumers; on the State level, absence of policies directed toward originating demand; inexpensive volume of financial investments; competition with large multinational corporations that generally do not transfer to regional subsidiaries technological achievements of R&D laboratories at their matrix that are located in developed countries.

To attract foreign investment to Latin America and the Caribbean favorable conditions for strengthening scientific and technological capacity such as encouraging strategic alliances. with specialized firms and stimulating the necessity of harmonizing intellectual property laws in biotechnology should be introduced. Last, there is a need to expand markets by introducing policies directed at a more equitable social income profile.

With concentration of industrial biotechnology in developing countries and its growing privatization, Latin America and the Caribbean are now facing the dilemma of whether to introduce patent rights for these products.

Solleiro (1990) argues that the regional systems of industrial property does not guarantee required incentives for technological innovation and does not constitute useful mechanisms for the diffusion of scientific knowledge. The level of biotechnological development. is extremely heterogeneous in the countries of the region, but their regulatory efforts are not harmonious. Moreover, in the current international context, they frequently perform under pressure from the United States which is engaged world-wide in introducing their standards for intellectual property rights in biotechnology.

TABLE VI REQUIREMENT ESTIMATES AND PRODUCTION CAPACITIES, IN 1990, OF EPI VACCINES (IN MILLIONS OF DOSES)

Vaccines	*Estimate Requirements 1990 (a)*	1990 *Production Capacities*	
		Nominal	*Real*
Against Poliomyelitis	53	30	14
Against Measles	24	18	14
DPT	70	333	14
TT (b)	50	26	14
BCG	30	30	26

(a) For babies less than one year old, the calculation was based on 15 million babies plus 20% wasted.
(b) 18 million pregnant women estimated for 1990.
Source: Pan American Health Organization. Las condiciones de Salud en las Américas, Washington, D. C., Publicación Científica Nº 524, vol. 1: 304, 1990.

TABLE VII LATIN AMERICA AND CARIBBEAN PARTICIPATION IN VACCINE DEVELOPMENT

Diseases and Vaccine	*Participants from Latin America and Caribbean*	*Developed Countries*	*Current Situation*
Rotavirus	Brazil, Peru 3	United States 1, 2, 3	3

Rabies (CRL vaccine)	Chile 1, 2, 3 CEPANZO		Finished in 1964
Yellow Fever	Colombia 1, 3 Brazil 1, 3	United States 1, 2, 3	Finished in 1939
Argentina Hemorrhagic Fever	Argentina 1, 2, 3 (Junin)	United States 1, 2, 3	Finished in 1990
B Hepatitis (recombinant vaccine)	Cuba 1, 2, 3	--	3
B Meningococcus Meningitis	Cuba 1, 2, 3	United States 1, 2	3
Leprosy	Venezuela 1, 2, 3	United States 1, 2, 3	3
Typhoid Fever			
-Weakened Vaccine	Chile 3	Switzerland 1, 2, 3	WHO Norms in 1984
-Vi Antigen Vaccine	Chile 3	United States 1, 2, 3	Finished in 1989
-Porines	Mexico 1, 2	--	3
Malaria	Colombia 1, 2, 3	United States 1, 2	3
(Synthetic Vaccine)	Venezuela 3		
Amebiasis	Mexico 1, 2	United States and others 1, 2	Scarcely developed
Leishmaniasis	Brazil 1, 2, 3 Venezuela 1, 2, 3	-	3 3

1. Serumepidemiological Studies.
2. Vaccine Development.
3. Clinical Assays in Humans.

Source: Pan American Health Organization. Vaccines Regional System for Latin America and the Caribbean (SIREVA). Feasibility Studies Washington, D. C., May, 1991.

Despite these structural difficulties and since investment for R&D predominates at the international level, it is still possible to identify niches of strategic opportunities for the development of industrial biotechnology in public health priorities of Latin American and Caribbean countries.

The national States should play an inevitable but fundamental role in the development of industrial biotechnology by strengthening basic infra-structures for science and technology, and by formulating policies for technological innovation, especially through fiscal tools and the introduction of required safeguards to the regulation of intellectual property rights, as well as raising financial support for scientific activities.

Finally, the authors emphasize that in the face of the growing privatization of industrial biotechnology a complete redirection should occur in the course of international negotiations on these subjects. Otherwise, biotechnology will never provide the primary resources needed to reach public health goals for Latin America, the Caribbean and other Third World countries.

REFERENCES

Commandeur, P. (1993): Latin America commences to 'biotechnologize' its industry. Biotechnology and Development Monitor Nº 14, March, p. 3-5.

Correa, C. M. (l991): The pharmaceutical industry and biotechnology - opportunities and constraints for developing countries. World Competition, vol. 15, n. 2, December, p. 43-63.

Correa, C. M. (1992): Políticas de desarrollo biotecnológico en América Latina. In: Formulación de políticas para el desarrollo de la biotecnología en América Latina y el Caribe (eds.) Walter R. Jaffé, María E. Zaldívar, Instituto Interamericano de Cooperación para la Agricultura. Programa de Generación y Transferencia de Tecnología, San José, Costa Rica, p. 123-146.

Dembo D.; Dias, C. J. and Morehouse, W. (1989): The vital nexus in Biotechnology: the relationship between research and production and its implications for Latin America. *Interciencia,* vol. 14, nº 4 July-August, p. 168-180.

Fundação Oswaldo Cruz (1987): *Biotecnologia em Saúde no Brasil. Limitações e Perspectivas.* Série Política de Saúde nº 3, Rio de Janeiro, 92 p.

Goldstein, D. J. (1991): Implications of the biotechnology in the Third World. J. Sci. *Ind. Res.* vol. 50 June, p. 432-440.

Panamerican Health Organization (1990): Las Condiciones de Salud en las Américas. Washington, D.C., *Publicación Científica* nº 524, vol. 1.

Panamerican Health Organization (1991): Vaccines Regional System for Latin America and the Caribbean (SIREVA). Feasibility Studies, Washington, D. C.

Orrego, C. (1987): *Opciones para un Programa Regional de Biotecnología.* Informe para el Departamento de Asuntos Científicos y Tecnológicos de la Organización de Estados Americanos Basado en una Gira por siete Países de América Latina (mimeografiado), Berkeley, California.

Quintero, R. (1991): Brasil está fora do mercado de medicamentos. *Gazeta Mercantil,* Río de Janeiro.

Robbins, A. and Freeman, P. (1988): Obstacles to Developing Vaccines for the Third World. *Scientific American, p.* 90-5.

Solleiro, J. L. (1990): Patentes en Biotecnología: oportunidades, amenazas y opciones para América Latina. *Revista del Derecho Industrial,* Buenos Aires, año 12, nº 34, p. 107-142.

UNDP/BIO-RIO (1990): *La Biotecnología Industrial en América Latina y el Caribe.* Bernardo Sorj. (org.), Rio de Janeiro 124 p

Atrás / Back / Voltar