

Pharmaceutical Biotechnology in India as a Growing Field

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ABSTRACT

Biotechnology is the science of today and tomorrow. It has application in all major service sectors of the society that is health, agriculture, industry and environment. Through the combined efforts of government, academia, research and industrial sectors, India is poised to become a major hub and logistics operation centre for R&D, manufacturing, and operations in the biotechnology and pharmaceutical industries within the Asia-Pacific region. There are several factors, which makes the biotech scenario bright in India. The future of pharmaceutical biotechnology in India holds immense potential if the biotechnology firms tap the big growth avenues to develop drugs for rare diseases.

Keywords: Biotechnology, agriculture, industry.

INTRODUCTION

Biotechnology is defined as the use of living organisms or parts of organisms to create products, processes and services. Four categories of biotechnology have been defined: 'Green Biotechnology', which concerns the biotechnology of plants; 'Red Biotechnology', related to medical and healthcare applications; Blue Biotechnology also known as Marine biotechnology, involves a number of technologies that transform products from the ocean into new foods, drugs, chemicals, and other products and 'White Biotechnology' also known as grey biotechnology, aimed at industrial uses. The development and application of Biotechnology in each of these four categories have been touted as catalysts and engines of growth for many countries, including developing countries.^[1]

Biotechnology can be used to create wealth. In fact, it has been identified as a major avenue for the socio-economic advancement of developing countries. The scope, scale and practice of biotechnology research and development currently being carried out in many developing countries present a range of entrepreneurial opportunities for enhancing technological progress and ultimately a nation's economic and social wealth.

The development of biotechnology as a pharmaceutical industry requires complex multidisciplinary and transdisciplinary efforts, including collaboration between scientists working in such fields as chemistry, microbiology,

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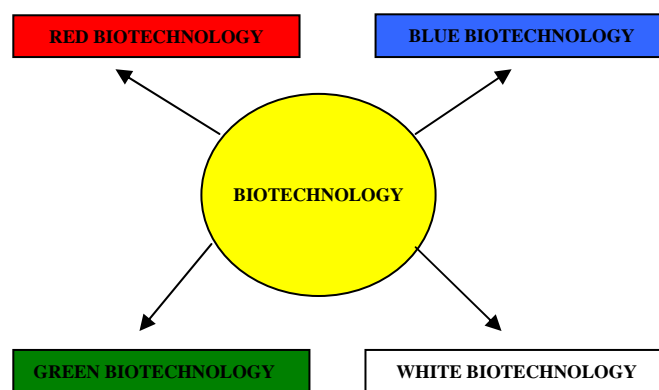


Fig. 1: Showing different categories of biotechnology.

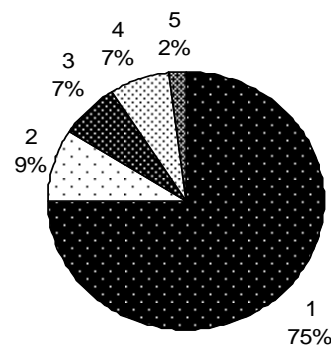


Fig. 2: Pie chart showing percentage of different biotechnology segments in India^[3]

molecular biology, pharmacology, physiology, genomics and proteomics. Non-science sectors, such as sales and marketing, also need to be involved. To develop and commercialize a biotech product, therefore, requires a synergistic strategy that brings together each of these

components. In much of the developing world, where research is carried out mainly in the public sector, there is also a need to forge strategic alliances between the public and private sectors.

Indian biotech companies are taking path of global collaborations. The biotech industry in India, mainly consisting of five distinct segments- BioPharma (1), Bioservices (2), BioAgriculture (3), BioIndustrial (4) and BioInformatics (5).^[2]

Challenges^[4]

Among the challenges facing the development of biotechnology based pharmaceutical industries in India, are:

- ❖ Financing
- ❖ Capacity building
- ❖ Training of entrepreneurial scientists
- ❖ Defining of markets
- ❖ Lack of harmonization of policies
- ❖ Curbing government bureaucracy

Opportunities^[5]

Despite these challenges, there are several opportunities for pharmaceutical biotechnology to grow in India. These include:

- Translation of scientific knowledge into commercial businesses.
- Exploiting strategic advantages such as biodiversity.
- Developing genetic modification technology.
- Creating auxiliary services.
- Trained human resources and knowledge base.
- Good network of research laboratories.
- Well developed base industries.
- Access to intellectual resources of NRI's in this area.
- Extensive clinical trials and research access to vast and diverse diseases in the huge population.
- India's human gene pools and unique plant, animals and microbial diversity offer an exciting opportunity for genomic research.
- Several labs have commenced research in stem cell and have valuable stem cell lines.
- Large domestic market and export potential.
- Low cost research base for international companies compared with other countries.
- Supportive Government policy on embryonic stem cells research provides a useful opportunity for international companies to pursue such research in India.

Strategies

Strategies for developing pharmaceutical industrial applications of biotechnology in India, therefore, should:

- ❖ Create enterprises
- ❖ Establish and promote close links
- ❖ Tackle intellectual property issues and take advantage of local biodiversity, indigenous knowledge and science-based innovations
- ❖ Seek involvement in key national economic development programmes.
- ❖ Leverage large population bases
- ❖ Maintain long-term vision

Disadvantages

- Missing links between research and commercialization.

- Lack of venture capital.
- Relatively low R&D expenditure by industry.
- Image of Indian pharma industry - doubts about ability of Indian products to meet International standards of quality.
- Inadequate protection of Intellectual Properties Rights (IPR), significant improvement remains to be undertaken in the areas of implementation and enforcement.

It is indeed conducive for the growth of biotech as Indian scientists are gearing up to meet any challenge, especially after the completion of the Human Genome Project. There are several factors, which makes the biotech scenario bright in India. Biotechnology especially, is gaining prominence in India & Asia Pacific region with many research institutions, university departments and corporate sector companies engaging in biotech research activities. In India alone, there are 200 research institutes and universities and more than 100 companies involved in biotech activities. With IPR coming into play after 2005, many Indian pharmaceutical companies are gearing for the genome battle. India has a large market for biotech-based products, most of these are imported.

Diagnostic market is still untapped with latest cutting edge technologies using molecular science. With increased funding for biotech activities by foreign investors and large Indian corporate and also the growing presence of many MNCs in basic research and clinical research like Pfizer, Eli Lilly, Quintiles, etc due to cost advantage for new drug development, India will be the destiny for larger portion of future drug research.

This is also evidenced by number of collaborations and alliances happening with Indian pharma companies. India also has manpower cost-advantages and easier scalability to higher production levels by increasing the number of people at a marginal increase in cost. India has a very good pool of scientific talent available at a significantly lower cost.

There is an enormous potential for the biotech products and services. The products include new diagnostic kits to identify infectious diseases, reagents to extract nucleic acids and several services that can be utilized in drug discovery and development. The Indian market is not yet matured for high-end services like gene expression analysis except for few pharmaceutical companies and research institutions. However, biotech market sizes are promising in countries like Singapore and in the Asia Pacific region. And more and more pharma and research institutes from the West are looking at India for contract research business as the scientific pool is talented and operational and infrastructural costs are reasonably low.

Moreover, India has immense market potential for Custom Laboratory Services. Presently, most of the biotech-based products are imported. The current Indian market size for diagnostics is Rs 6,500 crores. Monoclonal and polyclonal antibodies for disease immuno-diagnosis, tissue typing, clinical assays and research constitute a huge portion of the market.

THE 7 STEPS TO GLORY^[6]

The Indian biotech industry is at crossroads. On one hand, the country is being increasingly seen as a bio-manufacturing hub leveraging the advantages that accrue from operating in this geography & on the other hand, the domestic industry is repeatedly scaling up to participate in the global opportunities.

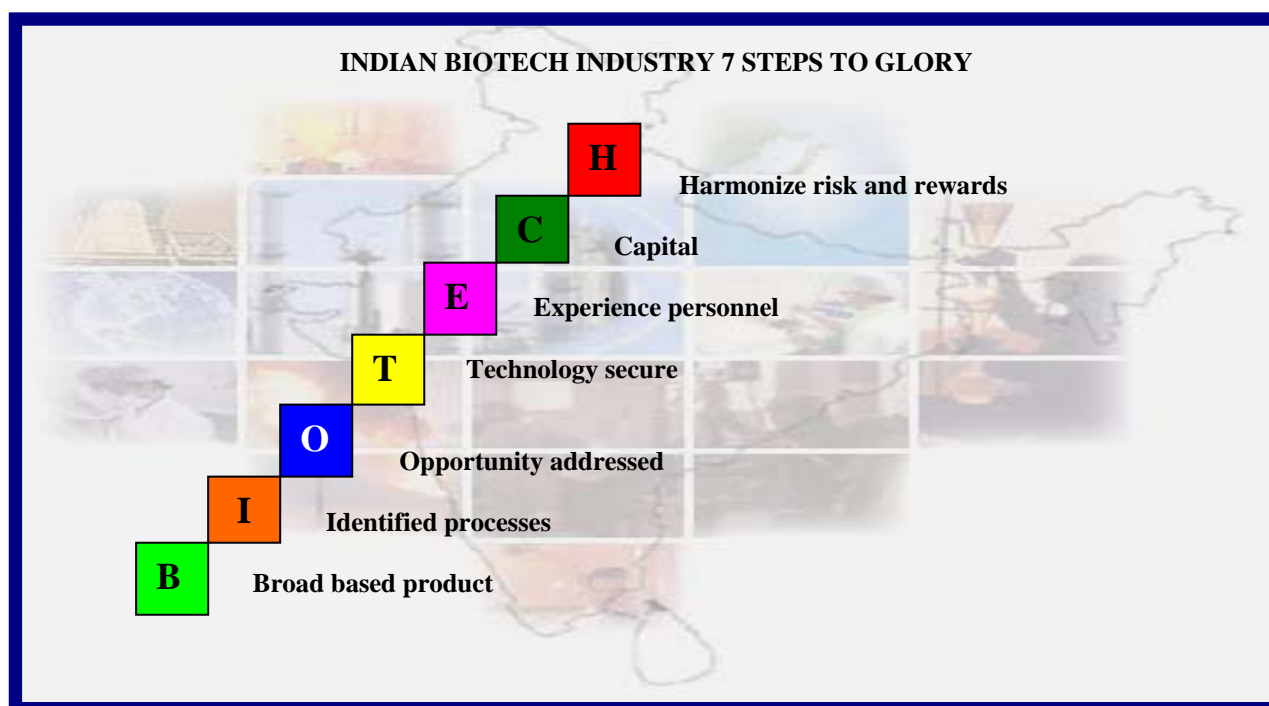


Fig. 3: Showing 7 steps to glory of Indian biotech industry.

Table 1: List of Major Biotech Players in India ^[8]

S. No.	Company	Product Segments	URL
1	Biocon (Bangalore)	Food and industrial enzymes, Statins, Lovastatin, Genomics, Chemical synthesis Molecular Biology	www.biocon.com
2	Panacea Biotech (Delhi)	NDDS for Anti TB combination drug, diabetic, asthma, Hep B vaccine	www.panaceabiotec.com
3	Wipro Health Science (Bangalore)	Diagnostics, DNA sequencing, flow cytometry	www.wipro.com
4	Haffkine Biopharmaceuticals (Mumbai)	Vaccines and Diagnostic Kits	www.vaccinehaffkine.com
5	Elli Lilly (Gurgaon)	Humlog, Huminsulin for diabetes	www.lilly.com
6	Nicholas Piramal (Mumbai)	Bioinformatics, genomics (Gen Med) in cardiovascular, diabetes and cancer	www.nicholaspiramal.com
7	Krebs Biochemicals (Hyderabad)	Statin agents for cholesterol	www.krebsbiochem.com
8	Bharat Serums and vaccines (Mumbai)	Vaccines, antibody and NDDS	www.bharatserums.com
9	Bio-Rad Lab (Gurgaon)	Diagnostics, reagents, protein purification	www.biorad.com
10	Shantha Biotech (Hyderabad)	Plasminogen activators, interferons, vaccines	www.shanthabiotech.com
11	Dr. Reddy's Lab (Hyderabad)	Therapeutic protein through recombinant DNA technology, cancer vaccine GCSF diagnostic protein for HIV infection, therapeutic protein for vaccines, cytokines and antivirals	www.drreddys.com

STATUS OF PHARMACEUTICAL BIOTECHNOLOGY IN INDIA ^[7]

Indian Biotech industry has been a late starter, only a decade ago, the contribution of Indian Biotech Sector to global biotechnology market was insignificant. There were only a handful of Biotech companies in India; many of entrepreneurs have made their mark in national as well as international arena. An Ernst and Young survey ranks India third in the Asia-Pacific region based on the number of biotech companies in the country and recognizes India as one of the emerging biotech leaders. Not surprisingly, this sector has been witnessing heightened activity, having already attracted as many as 150 multinationals. Apart from the existing talent pool of trained and skilled human resource, numerous scientists and regulatory experts, India's strong base for pharmaceutical research and IT services and well-educated low-cost English-speaking human capital are driving the off-shoring of biotechnology services to India. Indian biotech sector is gaining global visibility and being tracked for emerging investment opportunities. According to international experts, the period 2010-2020 has become

projected as the 'decade of Asia' in the field of pharmaceutical biotechnology.

BIOTECHNOLOGY AND ITS IMPACT ON DRUG DEVELOPMENT

Biotechnology finds varied applications such as in medical and pharmaceutical sciences, agriculture, food science, environmental improvement and in forensic science. But the most spectacular and beneficial results for human beings which have occurred from the advances made during the last two decades by biotechnology are in the area of medicine and pharmaceuticals. Biotechnology produced human insulin; growth hormone and erythropoietin are the glaring examples of the therapeutic agents in use. ^[9]

India has a very good track record of development of improved cost beneficial chemical synthesis for various drug molecules. With the expertise and experience through backward integration of technologies/ products developed elsewhere, Indian Pharma is now focusing on in house R&D for the development of new technologies and new drugs. Another area catching up India is contract research and in the area of clinical trials. India with a lot of diversification is indeed looked upon as an ideal base for clinical trial. ^[10]

BIOTECHNOLOGY SCENARIOS FOR MEDICAL APPLICATIONS IN FUTURE ^[1]**Scenario BB: Biotech Boost**

After 2005, the biotech market for medical application has not only achieved double digit growth rates, it has even continued to grow at the astonishing pace of 20 % per year on average over the last 10 years since 2005. Growth at such a speed has generated a market capitalization of 2,500 billion ERU as by now (2015). Because of the continued attractiveness of the biotech market, private but also public investors were willing to supply enormous funds in venture capital and for R&D sponsoring so that nowadays the industry is able to serve the bottom of the pyramid.

Scenario BBM: Biotech Business Matures

Major players in biotech as well as private and public investors in medical biotech research had expected a revolution in medical applications, grace to a vastly increased knowledge and fundamental research base and thus a vast universe of opportunities for new applications with shrinking R&D cost. This has not happened. Developing successful applications upon the vast knowledge base in biotech turned out to be much more difficult and much more expensive than expected. The rate of innovation finally didn't turn out to be higher than it was in the years and decades before.

Scenario BBB: Biotech Bubble Burst

May be it was the recent memory of the dot.com rise and fall that eventually led to the dramatic and turbulent changes in the biotech industry. In any case it had many similarities. In the early years of the 21st century, the biotech industry could look back on a period of 20 years with growth rates of around 20 %. The total market capitalization of the Biotech industry was more than \$300 billion in 2005. So, nobody was really prepared for what was to come.

SCOPE OF CONTRACT RESEARCH IN PHARMACEUTICAL BIOTECHNOLOGY IN INDIA

Biotechnology as an application science has taken firm in countries abroad where number of transgenic crops, genetically modified food and recombinant therapeutic molecules for human and animal health are available in market. It is essential to identify different steps involved in development of a drug, transgenic or biological and work on strategies to involve industries or institutions for specific roles. Though some Indian biotech companies have undertaken contract research for American and European labs and industries. They are doing only a small module for them and entirely controlled by them. In such cases, Indian laboratories are unable to do any innovative thinking and are failing to visualize them as multinational. The purpose of contract research should be:

1. Innovative thinking and competence in molecular biology, biotechnology, biochemistry, bio-processing, mouse genetic and assay development
2. Bench top R&D experiments
3. Discovery of new molecular modifications and improvement of existing drugs
4. High throughput screening for therapeutics
5. Stability testing; analytical development and validation
6. Provision of testing, facilities including testing in human cell lines
7. Drug delivery research
8. Clinical trial services

9. Clinical trials managements, data management, biostatistical analysis
10. Designing of facilities for commercial production
 - cGMP facilities
 - Small to mid-scale manufacturing
 - Pilot scale-up and production scale up
11. Contract packaging and manufacturing
12. Providing contractual regulatory affairs services
13. Industrial training and publishing
14. Providing pool of trained scientists or lab resources

Pharmaceutical biotechnology based companies are increasingly outsourcing early-stage research and clinical studies driven mainly by rising R&D costs and the need to improve R&D productivity. With cost saving of around 30-50 % compared to Western costs as well as an abundance of talented scientist and easy access to raw materials, India is seen as a key location for outsourcing research and manufacturing in the area of drug discovery and development.

India biotech sector is among the fastest growing knowledge based sectors, growing from USD 800 million in 2003 to USD 1.45 billion in 2005, and reaching USD 2 billion in 2008. Over the past few years, the biotech industry has invested around 25 % of its revenues with a high proportion of the investments going into setting up of infrastructures, followed by R&D.

By decreasing their in-house facilities and staff, and outsourcing more of their R&D functions, pharmaceutical biotechnology based companies are reshaping the drug development services industry. Outsourcing is not a new concept to pharmaceutical companies; however, its use increased dramatically in the mid-1990s, and it is expected to continue to increase going forward. It is estimated by 2020 nearly 62 % of all pharmaceutical drug development expenditures will be committed to outsourcing, as compared to the 4 % that was outsourced in the early-1990s. Some estimate that there are currently over 1,200 organizations involved in the clinical research, including pharmaceutical and biotechnology in-house clinical research, site management organizations (SMOs), academic medical centers, private research sites, and contract research organizations (CROs).

It is imperative that pharmaceutical biotechnology based companies pass their product through the testing and regulatory process in a rapid, cost effective manner. To accomplish this goal, pharmaceutical biotechnology based their therapeutics to market faster. These are some factors for driving contract research strategy-

1. Cost Reduction Strategy
2. Increasing Number of New Chemical Entities (NCEs) in Pipeline
3. Time to Market Pressures
4. Growing Complexity of Regulatory Requirements
5. Rapid Access to Patient Recruiting

Many Indian pharmaceutical biotechnology based companies have introduced products of original research through transfer from R&D institutions in India in the field of vaccines, diagnostics and clinical and contract research and trials. Some others have established tie ups and joint venture with foreign companies for sourcing technologies, with a view to introduce them into the Indian market within the framework of Indian laws. Outsourcing of R&D and over 20 conducting research in specific areas of pharmaceutical

biotechnology. In addition of these, there are companies in Bangalore with excellent technical manpower and world-renowned institutions such as the Indian Institute of Science (IISc), the National Centre for Biological Sciences (NCBS), Jawahar Lal Nehru Centre for Advanced Scientific Research (JNCASR), Center for Cellular and Molecular Biology (CCMB), Hyderabad, National Facility for Macromolecular Crystallography, BARC, Mumbai, National Facility for High Field NMR, TIFR, Mumbai, Central Drug Research Institute, Lucknow, National Brain Research Center, New Delhi, all of which provide high-quality R&D services to organizations worldwide. There are some contract research competitors such as Academic Medical Centres and Teaching Hospitals, Contract Research Organisations, Preclinical and Clinical Laboratory Services and Site Management Organizations.

INDIAN PHARMACEUTICAL AND BIOTECH INDUSTRY DEVELOPMENT STRATEGIES

Through the combined efforts of government, academia, research and industrial sectors, India is poised to become a major hub and logistics operation centre for R&D, manufacturing, and operations in the biotechnology and pharmaceutical industries within the Asia-Pacific region. The government's plans to promote industry include achieving targets of NT\$150 billion (US\$ 4.34 billion) in investments and 25 % annual revenue growth by 2010 and five hundred biotech-related companies within ten years. Industry, institutions and governments bodies all follow development guideline as set forth in the Promotion Plan for the biotechnology industry. A major aspect of the promotion plans is that it is identified specific in need of attention to upgrade not only the local biotech industry but also to enhance the investment attraction of India to the overseas life science community. These five areas of attention are as follows:

1. Related laws and regulations
2. R&D and application
3. Technology transfer and commercialization
4. Investment promotion and cooperation
5. Marketing information and services

FUTURE PROSPECTS OF THE PHARMACEUTICAL BIOTECHNOLOGY SECTORS IN INDIA

India is becoming one of the favored destinations for pharmaceutical based contract research:

- ❖ The biotech companies are expanding in a big way and assuming the global scale. For e.g.: Syngene, one of the *Biocon groups* of companies involved in contract research is expanding hugely in terms of scientific man power, and it is also acquiring a German biotech company as part of its expansion programs.
- ❖ Astra Zeneca and Pfizer are the two dominant companies in this category and by far the largest. Biovitrum focuses on metabolic diseases, obesity, type 2 diabetes and oncology.^[11]
- ❖ Active Biotech AB (immunology, vaccines, drugs) and SBL Vaccine AB (vaccines), KaroBio AB, A Carlsson Research AB and Medivir AB.^[12]
- ❖ Southern India (Hyderabad, Bangalore and Chennai) is emerging as a hub of novel research in biotech and pharma industry. In western India also the growth of Biotech sector is seem to be almost in equal measures with southern Biotech industries.

- ❖ Two global Biotech companies; Amgen and Biogen have set up wholly owned subsidiaries in the country. Which means that there is going to be creation of a lot of opportunities.
- ❖ As per the latest news, Ranbaxy, one of the leading Biotech & Pharma Company had become a part of Japanese Biotech Company, with more of expansions in its research operation and manufacturing sector leading to the creation of opportunities in the next years.

While India represents one of the biggest business opportunities for biotechnology in healthcare and pharmaceuticals, on account of its huge disease population, it is emerging as the bio-power of the world with its qualified scientific pool and innovative research and manufacturing efforts. The future of pharmaceutical biotechnology in India holds immense potential if the biotechnology firms tap the big growth avenues to develop drugs for rare diseases.

CONCLUSION

Pharmaceutical biotechnology has very good future in India. There is a lot that can be done to benefit India, using biotechnology. A proper balance between strategic research, product planning and effective collaboration will help support biotech growth in India. Partnerships with global biotech industries have the greatest impact on India's own biobusiness markets. Biotechnology companies are currently responsible for a majority of the innovation in the healthcare industry. The same is true of the pharmaceutical sector, where it is expected that innovations in biotechnology will revolutionize the pharmaceutical sector. The Indian Pharma Biotech Industry is set for rapid growth fueled by the growing market size and number of products as well as increased investments. The emergence of Biotech parks and state-of-the-art Bio-IT parks will further boost this growth. Although we may continue to see some big pharmaceutical companies acquiring biotechnology companies, they may have to cough up increasing amounts for their smaller siblings to clinch the deals. To appreciate the impact of biotechnology in pharmaceutical science an understanding of some basics of genetics is necessary.

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