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Review article

Future aspects of biotechnology and biological science in India

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ABSTRACT

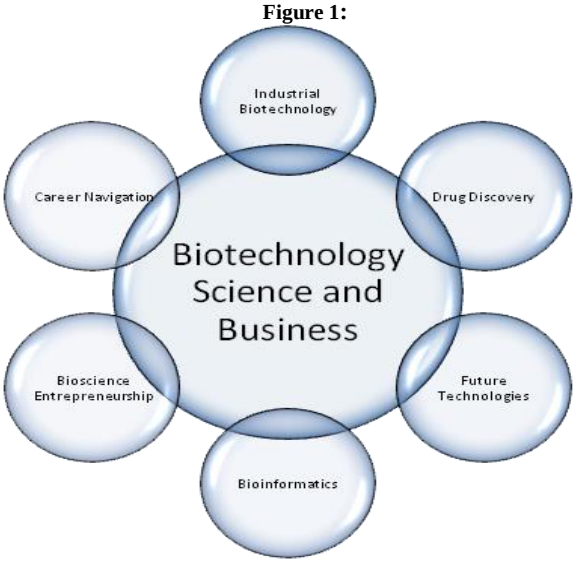
Everybody wants to enter a field which is hot one such field is biotechnolog, Biotechnology has prcious scope, Its new and booming field and most important there is less saturation. Biotechnology is the offshoot of science in which livings being are used for production. Students, who have keen interest in Biotechnology and want to make their bright future in this field, have a lot of career opportunities in this field. Scientists, Pharmacists, Biomedical engineer, Medical scientists, Lecturer, Patent agents, Patent lawyer etc. Biotechnology is an interdisciplinary Science; it is like a growing tree. About a dozen of specialization branches of science like Biochemistry, Molecular biology, Cell biology, Bioinformatics, Chemical engineering, Food science, material science and so an these are the root of biotechnologynological tree, and animal health, Vaccine, Crop yields, Environmental monitoring, pollution control, Therapeutics are the applications of this branch. The term biotechnology was introduced by Karl Ereky in 1917. He used the term for large scale culture of pigs by the use of sugar beets the source of food material.. As biotechnology is a subject with lot of promises, students are getting attracted to this stream of science and with India emerging as one of the biggest leader in biotechnology.

Keywords: Therapeutics, techniques, micro-organism, Bioinformatics, DNA.

INTRODUCTION

Hyperlipidemia The term biotechnology made up of two words bio= living and techniques that mean tools and accessories , So now we can defined biotechnology in simple, tools and techniques applied on living thing like flora and fauna and micro-organism for useful production. In this way we defined the biotechnology “The use of microbial, animal or plant cells or enzymes to synthesize, breakdown or transform material”. Biotechnology is old as human civilization; Man began employing micro-organism as early as 5,000 B.C. for making wine, vinegar, curd, bread etc. It involves production of newer and viable products or developing older products into cheaper and more effecting forms. Biotechnology is not just used in laboratories to modify genes. We all use biotechnology in our everyday lives – from lipstick to laundry to lunch. Biotechnology is about genetic modification or cloning and Biotechnology is used in our homes every day and our lives would be quite different without it. With the value addition of biotechnology, today it engulfs many disciplines of science and technology. Everybody wants to enter a field which is hot one such field is biotechnology, Biotechnology has good scope, Its new and booming field and most important there is less saturation. Biotechnology is the offshoot of science in which livings being are used for production. They includes Stem cell techniques, Microbiology, Gene Therapy, Immuno-technologies, Genetic engineering, Tissue culture, Enzyme engineering, Food biotechnology, Biosensor, Bioremediation, Bioinformatics, Photosynthetic efficiency, Marine biotechnology. Not to forget, Biotechnology’s valuable contribution in the Peptide synthesis, Rational drug design, Plant-based drugs, DNA vaccines Nutraceuticals, Cloning technologies, Organ transplantation, Latest drug-delivery systems, and Nano-biotechnology etc. has given it a special place.

Figure 1:



Scope of Biotechnology

Gene Therapy: This is a way, genetic engineering of humans, which would allow a person suffering from a disabling genetic disorder to lead a normal life. Gene therapy is boon for Scientist [1].

Immuno-technologies: Such as monoclonal antibodies (MABs) for diagnosis and therapy. Antibodies, special sets of proteins present in humans that enable them to fight incursion of their bodies by harmful chemicals or microorganisms. Monoclonal antibodies are single chemical species of antibodies produced in the laboratory by a special technique. Nobel Prize was awarded for this in the 1980 to Cesar Milstein and Georges Kashler. Mouse MABâ™s can be used for the diagnosis of human diseases. As human MABs are difficult to produce in the laboratory, genetically engineered plants are likely to find wide application in the production of human MABs [2].

Tissue culture: Tissue culture of both plant and animal cells. These are used for Micro propagation of elite or exotic materials (Such as orchids), production of useful compounds such as taxol (the widely used anti-cancer drug) and vanillin, and preparation in the laboratory of natural tissues such as arteries for arterial graft or skin for burn victims. (Modern tissue culture technologies allow the multiplication in the laboratory of cells isolated from plants and animals. In the case of plants, one can grow in the lab a whole plant from a single cell.) In the field of plant tissue culture researcher are improving our crops varieties, and discover more beneficial invention for green revolution.

Tissue Engineering: Artificial skin, Bio-artificial organs, Blood Substitutes, Neurological implants, Tissue engineered vascular grafts and various orthopedic devices.

Stem cell techniques: Stem cells are cells found in most, if not all, multi-cellular organisms they are characterized by the ability to renew themselves through mitotic cell division and differentiating into a diverse range of specialized cell types. Research in the stem cell field grew out of findings by Canadian scientists Ernest A. McCulloch and James E. Till in the 1960s.The two broad types of mammalian stem cells are: embryonic stem cells that are isolated from the inner cell mass of blasto cysts, and adult stem cells that are found in adult tissues. In a developing embryo, stem cells can differentiate into all of the specialized embryonic tissues. In adult organisms, stem cells and progenitor cells act as a repair system for the body, replenishing specialized cells, but also maintain the normal turnover of regenerative organs, such as blood, skin or intestinal tissues. Stem cells can now be grown and transformed into specialized cells with characteristics consistent with cells of various tissues such as muscles or nerves through cell culture. Highly plastic adult stem cells from a variety of sources, including umbilical cord blood and bone marrow, are routinely used in medical therapies. This would involve purification and isolation of stem cells from various tissues and develop into the desired tissue which could then be used, for example, for transplantation. Stem cells can be either totipotent (have the capability to produce any desired cell type or organ of the body under specific conditions) or they could be pluripotent (able to develop into several though not all cell types or organs). As embryonic stem cells are more likely totipotency than stem cells from adult tissues, the immediate emphasis in the area of stem cells is going to be first in the direction of establishing cell lines derived from early human embryos [3].

Figure 2: Mouse embryonic cells with florescent marker

Transgenic species

Transgenic mammals can produce selected human enzymes in their milk that have vast pharmaceutical applications. Dolly sheep is a very good example of transgenic technique as well as in agricultural field BT-cotton is also a transgenic species.

Pharmacogenomics and molecular profiling

Human growth hormone (HGH) may cosmetically enhance short, but otherwise perfectly healthy individuals [4].

Enzyme engineering and technology: Involves immobilized or stabilized enzymes, new classes of enzymes (ribozymes) or new enzymatic routes that produce important organic compounds. Enzymes are biological catalysts (Generally proteins) poised to replace inorganic catalysts. Photosynthetic efficiency: Increasing photosynthetic efficiency for biomass production in the Plant with the same amount of light and other inputs.

New DNA technologies

These include DNA fingerprinting, sequencing of genomes, development and use of new molecular markers for plant identification and characterization. Also the development of DNA-based probes for diagnosis of inherited disorders, antisense, technologies that are aimed at blockage of the function of a particular stretch of DNA.

Plant-based drugs

Use of modern biological techniques for validation, standardization and manufacture of indigenous plant-based drug formulations [5].

Peptide synthesis

Synthesis to make new drugs or other materials of industrial and commercial importance, such as salmon GnRH analogue (Ovaprim) to induce ovulation in fish. (Peptides are small proteins, generally containing less than 50 amino acid moieties.

Rational drug design

A decade or so ago, the only way to discover a new drug was to synthesize a large number of compounds hoping that one of them will be effective against a particular disease. And it cost something between half a billion to a billion dollars for bringing a new drug to the market. As a result we have not added more than ten new drugs per year to the repertoire of medicines already available. In rational drug design, we first identify the molecular target we wish to attack. To do so, it becomes necessary to understand the mechanism of causation of the disease. Once we understand this mechanism and identify the molecular target lead effective computerized programs to design a molecule, which would hit the target. This approach of designing a drug on a rational basis cuts the cost of discovery of a new and reduces the time required (Now 12-15 years) by half. We are more progressive for this field [6].

Nutraceuticals

That helps recovery after surgery or an episode of a major disease, or helps protect one against certain medical and health problems. For example, a Swedish company, Probi, has isolated a strain of Lactobacillus planetarum, which is apparently present in the digestive tract of Europeans and Amercians. (Indians have not yet been tested for its presence). The presence of this organism has been correlated with the ability of the person to recover after major surgery or after chemotherapy of cancer; this organism also seems to protect people against a vast range of stomach disorders including stomach ulcerts, irritable bowel syndrome and constipation. Therefore, marketing this organism in various forms, including a delicious soft drink [7].

Assisted reproductive technologies

Artificial insemination (Using husbandâ€™s or donor semen), invitro fertilization, intra cytoplasmic sperm injection and techniques involving egg donation, surrogate motherhood or embryo transfer etc are comes under this field. New cloning technologies: Cloning of genetically engineered animals that would produce useful products [8].

Organ transplantation

Xenotransplantation that is transplantation into humans of organs from other animals. It appears that pig may be the most suitable for this biochemically, anatomically and immunologically. The major problem in xenotransplantation is the hyper-acute immunological rejection of the foreign organ which occurs in a matter of minutes in entrains plantation. This problem has been recently overcome by identifying the molecular basis of the hyper-acute rejection and then genetically engineering a pig to avoid it. But in the case of a kidney transplant from one human donor to another human recipient (homotransplantation) this does not occur.

New drug-delivery systems: Such as lipsomes and transdermal patches, and the use of circadian rhythms to optimize the effectiveness of the drug. Thus the drug may depending on the circadian rhythm of the individual will be effective when taken at noon and midnight, than if taken at 6 am and 6pm.

Production of useful materials: Existing (for example, polyunsaturated fatty acids or beta- carotene, both of which are essential for normal vision) or new, from so far unutilized or underutilized but widely available resources such as marine organisms.

Production of new materials using new ideas

Observations or research findings, such as bacterial ropes or biodegradable polymers. For example, bacterial ropes that essentially consist of certain mutant bacteria that have the ability to grow into spagetti-like structures, when impregnated with certain metal ions can be stronger than steel but much lighter and biodegradable.

DNA vaccines

These vaccines are would be much cheaper than protein antigen-based vaccines that are generally used today. New medical diagnostic technologies: - such as combination of MRI and Pet-SCAN for correlation of structure and function in normal and diseased individuals.

Use of microbes

Microbes selected or genetically engineered for effecting chemically difficult transformations, for example in the field of steroids that are widely used as drugs.

Bioremediation: Effluents or waste, using biological systems. A septic tank and an oxidation pond are simple examples of such bioremediation. Production of biogas is value-added bioremediation.

Processing of low-grade ores using microorganisms

Commercially viable bio-processes are available today for processing such ores of over a dozen metals.

Bioinformatics, including genomics and proteomics

This newly emerging area makes use of the enormous amount of data on biological systems that are becoming available.

There are several million species known. The sequence of the building blocks of DNA of just one human being alone will fill nearly 700 books (typed single space) of 500 pages each.

Nano-biotechnology

In which the operating or useful unit is of the scale of, a nanometer Biotechnology is always non-polluting and, often labour intensive. They make use of replenishable natural resources and help their conservation. They help, directly or indirectly, in saving energy. Biotechnologies are less accident-prone. In spite of their high level of intellectual sophistication, it is easier to train people to handle Biotechnologies than other technologies. Above all, they are interesting and exciting for all those involved with them.

Sub fields of biotechnology

Biotechnology divides in three sub field

Red biotechnology

White biotechnology

Green biotechnology

Red biotechnology deals with genetically modified micro-organism, it has also deals with reproductive techniques like in vitro fertilization, DNA profiling, forensic and transplantation. White biotechnology is related to useful chemicals for the industrial sector through moulds or yeast, it has also related to environmental science and biodiversity conservation (DNA sample of endangered species are storing for future). Green biotechnology is concerned with agricultural biotechnology, in this field scientist trying to produce genetically modified plants and animals having good strain. Although people often look for study abroad programmers for studying biotechnology, the scope of biotechnology in India also tremendous. It is a field that emerge engineers, biologist, and many other such professional, According to survey conduct by Ernst and young, Asia is set to become a hotbed for bio-technology related research and development and India is supposed to emerge as destination which will see a notable expansion in the biotechnology. In an article M. Radhakrishnan Pillai, Director of Rajeev Gandhi Thirvantpuram, (stated to 'The Hindu'). Biotechnology does not exist in the B.Sc level. It will exit after it. It if you are planning to do biotechnology makes it a point that doesn't be lured by the idea of boom and the fact that it sounds cool take up biotechnology when you have a deep love subject and wish to make carrier and want to do authentic research.

Botechnology Industries in India

Biotechnology in India growing rapidly, It is one of the sunrise sector. The area where biotechnology has grown in India includes bioinformatics, agricultural biotechnology, bio-fertilizers, environmental science, and marine biotechnology so on. As biotechnology is a very good subject with lot of promises, students are starting attracted to this stream of science and with India emerging as one of the biggest leader in biotechnology. India has started attracting the global attention especially in the clinical trials, contract research and manufacturing and other service of bio-pharma segment (Raj Kumar dubey–Biotechnology destination in India). Now days 300 companies, are operating in all sector of biotechnology but there are only approximate 28 companies that have been gained size and are working in the modern biotechnology sector adrenal signee and quintiles(in the disservices), Serum Institute of India (in the biopharma space), Mahco Monsanto Rasi Seeds (in the agro biotechnology field), Strand Genomics, GVK biosciences (in the bioinformatics) Adrenal Signee and quintiles in the (biosciences), Beacon, Panacea, Ranbaxy, Reliance, Nicholas-Primal limited Etc. The Indian biotechnology industries are slated to become a US$ 5 billion industry by 2010; the product patent regime will come into force by the end of 2005 and will provide the strategic inputs for companies to invest in product research.

• There are so many opportunities for such investments in the Indian Biotechnology sector to an extent of Rs. 8 Billion that could result in a turnover of Rs.10 billion in the next 5-7 years.

• The Pharmaceutical Markets, are owing to the emergence of corporatisation in health care, growth of health insurance, deeper rural penetration, development of a strong market and marginilasation of the DPCO, is expected to cross $37 billion by (JIBL Vol 01 I 2004).Indian companies are also expanding overseas. The acquisition of percent stake of the German Pharma Axicorp by biocon is case testimony. Most of the industries and firms are located in six major cities of Dehli, Mumbai, Pune, Chennai, Banglore, Hyderabad and Ahemdabad. The biotechnology sector in India is still mainly a mix of small and medium-sized companies. Major hurdles for Indian biotechnology start-ups are finding seed capital, lack of researches and development focus, intellectual property rights, regulatory reforms and difficulty in competing with large companies in terms of salaries and benefits for key employees. Several national domestic players are competing in this market such as Serum Institute of India (Pune), Biocon, Panacea Biotechnology, etc. Major vaccines produced include DPT, DT, BCG, Tetanus toxoid, oral polio, measles, mumps, rubella, hepatitis B, rabies (tissue culture-based), and an injectible typhoid vaccine. The human and animal segment of the industry alone is growing by at least 20%. Human health biotechnology accounts for 60% of the total sales, while agro biotechnology and veterinary-biotechnology together account for 15% of the total revenue and medical devices, contract R&D and reagents and supplies constitute the remainder. Renu Swroop (DBT, Govt. of India) spoke on 'Recent trends in biotechnology, The Indian scenario, According to Her biotechnology has the potential to generate major economic health and environmental benefits.

Academics Scopes

Biotechnology unifies biology and zechnology by covering a wide range of subjects like agriculture, animal husbandry, biochemistry, bio-statistics, cell biology, chemistry, crop management, cropping system, ecology, engineering, genetics, molecular biology, health, immunology, medicine, microbiology, plant physiology, soil science, soil conservation, seed technology, and virology, etc. In biotechnology the living things, especially cells and bacteria are used in industrial process. Through these researches, various medicines, and vaccines are developed. Scope of biotechnology in India There is an immense possibility of getting jobs in this field as the demand for biotechnologynologists is growing in India as well as abroad. It is estimated that more than 6000 biotechnologynologists of top skill are required in India as per the survey made by the Human Resource Development Ministry. Eligibility criteria to get into the field of Biotechnology requires graduation in science that is in physics, chemistry and biology. There is B.Tech for the undergraduates. Some universities in India offer the B.Sc biotechnology for which you can join after class 12 or equivalent examination, with physics, chemistry and mathematics. Graduates in all sciences, engineering technology, or medicine are eligible for the postgraduate (M.Sc.) course in biotechnology. There are P.G. courses available in M.Sc. Biotechnology, M.Sc. (Agriculture) Biotechnology, M.V.Sc. (Animal) Biotechnology, and M.Tech. Biotechnology, M.Sc. M.V.Sc. in Veterinary Biotechnology, M.Sc. (Marine) Biotechnology and a host of other courses are available. Institutes that provide biotechnology course Here are some well-known institutions of biotechnology, which offer graduate courses in the subjects, Indian Institute of Science, Bangalore, Indian Agricultural Research Institute, New Delhi ,Indian Institute of Technology, New Delhi , GB Pant University of Agriculture and Technology, Uttar Pradesh ,National Centre for Plant Genome Research, New Delhi. National Institute of Immunology, New Delhi, National Dairy Research Institute, Bangalore The following are some of the universities that also offer graduate and post graduate courses in biotechnology, Osmania University, Hyderabad, Andhra Pradesh, Visvha-Bharati, Birbhum, West Bengal, Madras University, Chennai, Tamil Nadu, Biotechnology University of Mysore, Karnataka, Andhra University, Visakhapatnam, Andhra Pradesh, Banaras Hindu University, Patna University, Bihar, Rajasthan University, Rajasthan, Biotechnology Bangalore University, Karnataka, Sai College Of Medical Science and Technology, Uttar Pradesh, Biotechnology Gulbarga University, Karnataka Jobs in biotechnology Bio-technology as a subject has grown rapidly. A biotechnologynologist can get into government institutes and organizations, such as Department of Biotechnology (DBT) and the Rajiv Gandhi Centre for Development of Education, Science and Technology at Thiruvananthapuram. Other fields include agriculture, dairy and horticulture institutes. Pharmaceutical companies like Dabur, Ranbaxy, Hindustan Lever, and Dr. Reddy's Labs, and many more. Food processing industry, chemical industry, and the textile industry are the other areas where you can look for jobs. Hindustan Lever, Thapar Group, Indo American Hybrid Seeds, Biocon India Ltd., IDPL, Hindustan Antibiotics, etc. Are some of the big companies that employ biotechnologynologists.

CONCLUSION

Remuneration in biotechnology field in India is the next biotechnology frontier and there's immense scope to earn a lot in this field, but as always, the more well-read you are more the amount you can expect. The factors for remuneration depend upon academic qualification, institute or university from which the degree is attained and the level of work experience. In the corporate sector, a fresher with B. Sc. or B. Tech. degree can expect somewhere from Rs. 5,000 to Rs. 7,000 per month. Candidates with master's degrees, PhDs, or research background can expect Rs. 10,000 to Rs. 15,000 per month. Last but not a least Salary increases with your experience, but due to lesser number of openings in this field as compared to other sectors, the salary hikes are low there for we already said that you choose biotechnology when you have deep desire for this subject.

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