

INNOVATION INCUBATION AND ENTREPRENEURSHIP IN BIOTECHNOLOGY- REVIEW

Arpit Srivastava¹, Vishwas Singh², Dr. Pradeep Srivastava³, Rupika Sinha³

¹Technology Business Incubator, Malaviya Centre for Innovation, Incubation & Entrepreneurship
Indian Institute of Technology Banaras Hindu University Varanasi (U.P.) – India 221005

²Lovely Professional University, NH1 Phagwara Punjab – India 144411

³School of Biochemical Engineering – IIT BHU, Varanasi (U.P.) – India 221005
arpitamity.biotech786@gmail.com

Abstract— Biotechnology is an emerging sector which not only includes medical science but also dynamic aspects of sustainable environment. In Entrepreneurial sector scope for Biotechnology is more but on a ground level this sector does not able to capitalize the market because of lack of information and heavy investment. In India Biotechnology based sector required for better medical research with a quality Output. The demands have to be highly observed and validate by designing platform for delivery of high value products through entrepreneurship developments. Medical research derives innovation from all the directions but to convert it into entrepreneurial aspect comes from Incubation of research, Product and its Yield for the betterment of Humans. Branches like Food, Natural Medicines, Bioinformatics, Biosensors, Waste management and different Therapies can be derived by entrepreneurial aspect and this paper will help to analyze different productive sectors of Biotechnology in Entrepreneurship.

Index Terms— Biotechnology, Biosensors, Bioinformatics, Entrepreneurship.

I. INTRODUCTION

Innovation, Incubation & Entrepreneurship are the three basic modules behind brief start-ups as it provide an area of employment, research and analytical advancement to a country. In these terms Innovation defined as novel idea which can fulfill all the demands at one time without any disadvantages. An innovation took birth when a former invention identified with many obstacles, such obstacles not only effect its production but it also loses faith in the globalized market. This is the time of globalization which demands fastness, on time approach which should be financially profitable then only it get identification in globalized market. In terms of biotechnology, innovation came in the earlier 19th century. Introduction to food biotechnology, in which preparation of curd from milk, preparation of cream, and many dairy products like cheese, butter etc were existing evidence from ancient Egypt. According to time line of biotechnology the history signified that biotechnology is not a singular term as it includes – microorganisms, food, agriculture, bio-chemicals,

environment, plants, animals, humans and technology. From the discovery of microscope by Janssen in 1509 to the discover cells in 1663 by Hook, innovation came into existence. After that different inventions and discoveries like proteins in 1830, enzymes in 1833, fermentation technology in 1857, immunology in 1902, and term- biotechnology was introduced in 1919 were occurred. This phenomenal advancement in the field of biotechnology is an igniting example that how much life science is adopting biotechnology not only in theoretical terms but also in technological means. Ideally such advancement in biotechnology helped many human studies like Human Genome Project of 2003 which has proved that how disease related study, physiology, morphological studies get much easier. Human genome project was one of the biggest innovative example in the field of biotechnology which has created new directions of treatment, cure and adhere life for a longer period of time, the evolutionary studies helped scientists to evolve our past. Now different Genome projects have been done which defines that how much technology is helping in Life science. Studies related to Thermodynamics, Mass transfer. Chemical reaction, Light etc all are related to biotechnology.

II. ENTREPRENEURSHIP IN BIOTECHNOLOGY

Biotechnology helped in making amendments for Pharmaceutical industry which is now called as HealthCare industry. Agriculture, Dairy, Food has been transcends by biotechnology. An innovative example from Food biotechnology is of “Edible Vaccines”& “Functional Foods”; till now researchers are observing that food contains many enriched particles which are essential for health and how they can be enhanced so to get retained in our body for longer period of time. The concept of functional food is not an individual, well-described or significant article. Indeed, various varieties of food materials are characterized as functional foods. These conclude a variety of compounds like nutrients and non-nutrients, influencing an array of body functions pertinent either to the condition of living being and health and to the miniature of peril of a disease. The Bioavailability of any particular or multiple components which positively affect the metabolic response occurring in human body is defined as Functional foods. Example in respect to innovation for

functional food is the use of anti-oxidants, omega-3 fatty acid, rice bran oil etc in food products. Functional foods are basically focusing on physical health which includes heart, liver, kidneys, bones and lungs. It also focusing on mental health that includes brain, relax from stress.

Introduction of High Density Lipoprotein (HDL) from Low Density Lipoprotein is creating awareness in the society about good and bad cholesterol. In India the maximum number of patients are suffering from heart diseases, in scientific terms, [1] Coronary Artery Diseases (CAD), the basic reason behind CAD is Oxidative Stress occur due to formation of plaques in arteries, blood vessels but in research findings it has been proved that, Nitric Oxide can play an important role in eradicating cardiac diseases and research is adhering the relationship between CAD and Functional Food.

A. Entrepreneurship in Food Biotechnology

The term Functional food is very different from Edible Vaccines and Nutraceuticals. In case of Edible Vaccines, are plant based or plant derived antigens based on the glycoprotein factor or any part of pathogen which can produce an immunological response. Plants are genetically modified with the help of Recombinant DNA technology to create transgenic plant species of novel characteristics, various food stuffs under observation like banana, potato, tomato, lettuce, rice, etc. Diet is one feature of an inclusive lifestyle loom to good health, which constantly include Meditation, Exercise, tobacco prohibition, less stress, maintenance of BMI and positive mental practices. When all of these issues are addressed, functional foods become part of an efficient approach to increase health and diminish disease peril. Edible vaccines [2] are developed for a number of humans and animals based diseases, including measles, cholera, foot and mouth disease and hepatitis B, C and E thus it is an innovative example around

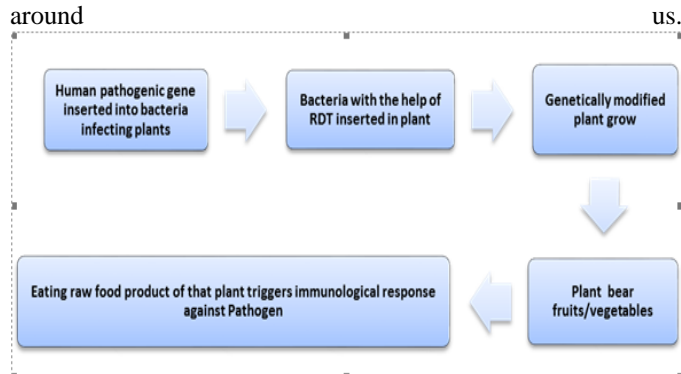


Figure 1. Concept of Edible Vaccine

It is a good innovative example but it is also necessary to identify that the innovative idea must not be contaminated by disadvantages, this is one of the important view during generating innovation especially in the field of biotechnology. Disadvantage, is the major issue of concern because any innovation of biotechnology is related to biological life which includes plants, animals and human beings. The concept of Edible vaccines has been identified with many disadvantages like –

1. Plants are living organisms that change, so the continuity of the vaccine production might not be assured.
2. The edible vaccines could be mistaken for regular fruits and consumed in larger amounts than might not be safe.
3. Glycosylation patterns in plants differ from those in humans and could affect the functionality of the vaccines.

The researchers had found threads in this invention, so it is necessary to determine the safety protocols. Therefore clinical trials are necessary in the field of biotechnology. Transformation of Pharmaceutical industries into Healthcare industries is also an innovative step which implement that formation of drug is not only the part of pharmaceutical department but they have to think one more step ahead that how one can do not serve the toxic effects of particular drug. Therefore this transformation not only based on the drugs but eventually they are working on natural products which have medicinal properties, they also started educating their customers in medicinal way, they adopt Ayurveda too and thus innovation happens. In the field of biotechnology Innovation gives birth to Incubation and then exemplifies the area of Entrepreneurship.

Entrepreneurship means a protocol for initiation of a business from small scale which aims innovative products and services and scale up by increasing the number of employs in several directions. A person who manufactures something and sell it on own price; this manufacturing and selling procedure by own in an innovative way defines Entrepreneurship and the persons who lead this called as an Entrepreneur. An Entrepreneur mind set initially focus on competition, demands and demerits of other companies and then an innovative idea helps them to grow slow in one direction and afterwards this slow growth get scale up and expand in the existing market. The incubating companies or Start ups of biotechnical field follow special critical guidelines of GMP & GLP. Technology based Incubation, e-commerce based Incubation etc are some of the categories present which expand the Personal Sector. Biotechnology being a vast field contains Food, Agriculture, Health, Pharmacy, Life-science and all such branches can be the part of Entrepreneurship. There are many food processing companies which are providing novel directions and procedures for making food more effective for the society. Economically entrepreneurs play a crucial role in developing country's capita. If we exemplify Food sector in India, being an agricultural based country serving biggest part in whole world after China and one of the largest industry in food sector is Food Processing industry. The food processing sector has ability to magnetize foreign market up to US\$ 33% of total food market of country. An empire of entrepreneurial business with Food biotechnology can stand in a profitable and economical way. Besides Food, one more sector in which India has a potential to build empire of entrepreneurial business is of Agriculture sector which not only provide globalize business but it also provide employment, benefits to Indian farmers by

providing advance technologies for better crop yield and other benefits.

The other curative sector for emerging entrepreneurial business is pharmaceutical industries which expanded with US\$5.3 billion and it was increased to \$12.6 billion as reported in 2012 and the estimated growth for domestic market in India by pharmaceutical industry would be US\$49 billion and in India the concept of "Bio-Pharmaceuticals" is contributing 60% from total market. The concept of Bio-Generic drugs, Nutraceuticals, Healthcare is transforming Indian market and entrepreneurs are modifying it in a sustainable way so that its benefit can reach to every citizen belongs to India ethically. Entrepreneurship runs parallel with ethics. Initially the pharmaceutical industry was totally chemical based and it has too many side effects but the concept of biological drugs which are beneficial as well as safe for human being, helping pharmaceutical industries to focus on such product which defines at low production cost with high yield. Another concept is identified by the researchers from biotechnology is "Generic medicines", which has provided a new direction in the field of pharmacy. India's growing economy \$182 billion food processing industry has been growing at over 13%, now this statement clarifies that how much innovation and entrepreneurship can be develop in this sector. Indian economy is based on, agriculture and now we are improvising this entrepreneurial sector called as "Food Processing". India's maximum economical benefit came from Food Processing Industry. Studies on different food supplements, preservatives, micro/macro nutrients created a new branch in the field of employment by expanding the field of Food Biotechnology. Now these industries are not manufacturing the food products but they also made a division which supervises both quantity and quality of food. Innovations have been seen in the sector of nutrients.

The value string in (FPI) Food Processing Industry initiates from Ranch and ends at Retailing and Services. The initial level of price string initiates by deliverance of ranch inputs, like food chemicals, seeds & bio-fertilizers etc. It also contains crop production, and assurance of crops beside any type of ordinary or artificial misfortune. This level also includes acquirement of food manufacture for retail addition. The second level is of marketing which includes storeroom and marketing of products; starts the magnitude of cold string amenities. The lack of appropriate cold storages amenities leads to squander of products, which hikes an amounts as higher as 34.5% of the total. This concerned issue has been ticked as very serious and critical confront in food industry; detailed by Entrepreneurs in a research conducted by FICCI [4]. The deal and allocation facilities also include transportation for export, and changing of products from one area to another and marketing of pure food produce. Then, the processing section initiates which contains Grinding, Classifying and Polishing in case of vegetable and fruit sector, refining, grinding in grains category like paddy-rice, wheat-flour. Then extra additives of wheat into noodles (innovations), bakery items with wheat, processed fruit and vegetables, juice extracts, oil free snacks etc. In the next level there is bulk

marketing of extra additive products, send of products and naming of food products. The introduction of big variety in food industries has made a quarrel contest for small skilled enterprise. The existence of MNC'S in the trade sector, prohibition of local companies to raise, due to be deficient in that broad variety and advertisement as well as trust of customers are not so reliable for local industries and make them to suffer loss. The closing level marked from Retailing and good services entail vending of price additive foods by various means like for seal packed food stuffs, grains etc. There is increment in price addition in many sectors of food industry with expand in stipulate for processed food products.

B. Entrepreneurship in Biotech Healthcare

The next we research that how much health care industries are taking initiatives for making a healthy future; invention of Monoclonal antibodies, Stem Cell engineering these innovative branches are leading in healthcare industries but in India the actual situation of these research areas are quite serious, issues like malnutrition, high blood pressure, diabetes are the major area of concern. Different types of medicinal therapies are in research for the development of drugs which can be useful without any side effects.

Advancement in "Phage Therapy" techniques, most of the clinical trials of phage therapy was a successful attempt for treating pathogenic bacterial infection. In India the advancement in Phage Therapy has been significantly raised when river Ganges becomes a part of observation for scientists. It was found that the impact factor of Phage therapy in India took an additional advantage when strains of *Shigella*, *Escherichia coli*, *Klebsiella*, *Pseudomonas aeruginosa*, *staphylococcus aureus* were treated by bacteriophages; excluding the temperate or lysogenic phages.

The applications Gene cloning, and DNA analysis, refer to Recombinant DNA technology which defines the industrial use of microorganisms. For example invention of Penicillin was one of the breakthrough inventions of 20th century which helped industries to focus on microorganism.

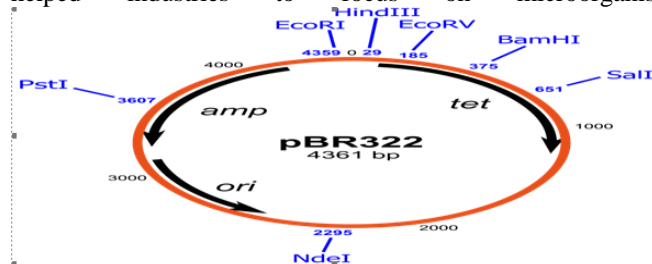


Figure 2. Gene Cloning vector pBR322

C. Entrepreneurship in Industrial Biotechnology

Fermentation technology came into existence when industries started using microorganisms for productive yield. On an initial stage formation of milk products in dairy industries like Cheese, butter etc was a remarkable example of applications of fermentation technology. Today more than 10,000 products either eatable or non-eatable items are made by the help of fermentation processing and 5,000 products are based on microbial natural synthesis [4]. "Gene Cloning" as a

principle factor works behind fermentation technology, for entrepreneurs it is important to understand the basic principles behind Gene cloning. It is defined as cloning of genes from (animals/plants) native host to cloning “vectors” and introduces a new bacterium; if the gene in this novel bacterium expressed correctly then it will synthesize recombinant protein of interest [5]. The basic aim behind recombinant protein production is – a. To provide better yield of product, b. To enhance quality of products. However the procedure is very critical, if sterilization is not done properly then it may cause damage to the genes. For incubating companies who are working in the field of Recombinant technology manage their R n D sectors with proper guidelines.

Pharming is an innovative concept came into existence after eukaryotic gene cloning. This defines recombinant protein from live plants and animals, for example uses of Silkworm for production of recombinant protein. In Pharming, a transgenic animal acts as a host for synthesis of protein; these proteins serve numerous therapeutic purposes such as treatment of Cystic Fibrosis, Hemophilia, Osteoporosis, Arthritis Malaria and HIV. A transgenic animal is one which has cloned genes in its cells which can be executed by nuclear transfer. There are many devices used in Nuclear Transfer Engineering and for entrepreneurs it is necessary to focus on delivering devices like – Gene gun, Micro injection needle, magic bullet, Electroporation technique, Gene Targeting etc. New Incubation companies can research in this field and they can provide more sophisticated devices/techniques of delivering either genes or nuclear transfer. Transgenic animals can also produce MoAb which is used in vaccine development. Transgenic animals are yet costly to produce as they costs \$20,000 to \$300,000 and only a small part get succeeded.

The animal biotechnology is one of the finest branch for novel innovators, there are many institutes who works in animal handling therefore these industries can adopt new technologies in an innovative way. Here are some examples of transgenic animals as well products on which these animals are focused.

Transgenic Animal	Drug / Protein	Use
Sheep	α -1Anti Trypsin	against Emphysema
Cow	Alpha-Lactalbumin	Anti infection
Goat	Pro -542	Treatment of HIV
Pig	Factor VIII, IX	Treatment of Hemophilia
Chicken	Monoclonal Antibodies	Vaccine production
Cow	Fibrinogen	Treatment of Hemophilia
Sheep	CFTR	Treatment of Cystic Fibrosis

Table 1. Applications of Transgenic Products

Novel incubating companies who want to excel biotech industries can consult biotech parks of India where they can work on prototypes of such inventive products. Preservation of recombinant products is also a new innovative branch for entrepreneurs in form of “Preservation Sector” under “Sustainable Biotechnological Research”; as the demand increased in past few years and preservation communities can directly contact to research labs, therefore it is necessary that incubating companies should follow Good Preservation Practices (GPP). Preservation of Cell lines, Blood samples, Proteins, Microbial strains etc are now becoming a part of entrepreneurship cell. For a better startup it is necessary that the company should follow GLP, GMP, and GPP.

D. Entrepreneurship In Bio-Sensing

Another field in which incubating companies can focus is defined under Biophysics; Biosensor technology is an innovative step in the field of biophysics. It was a complicated effort to convert biological data into digital data but with the invention of Biosensors the extraction of data becomes easier. A Biosensor is a “Self-contained Integrated” device which can provide quantitative information by recognizing a biological receptor element which is in direct contact with a transducer and an amplifier is attached to amplify the data on display.

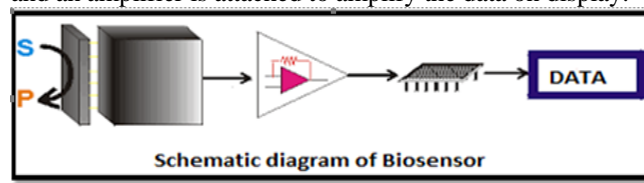


Figure 3. Schematic Diagram of Biosensor

It is necessary that how Biosensors can be the part of Entrepreneurship; the analytical instruments used in biosensor technology constitutes of a Biocatalyst element, a transducer, an Amplifier, a Processor and a Display. The working of a biosensor is based on the biological reaction occurring in nature. [6] The Bioreceptor is a device on which the reaction occurs further Transducer converts biological signals into electrical signals; it depends on the biological reaction that which type of transducer is required respectively. A membrane is also present which filters all impurities present in the sample before converting into electrical signals so to avoid errors in result. Biotech business incubators can excel their market by introducing innovative biosensors. This is a technical approach in the field of bioengineering, the applications of biosensors has now spread in every field as it provide error less figures of any biological sample. Biological samples need accurate results, there are numbers of reaction occur in our body like Glycolysis, Gluconeogenesis, β – oxidation etc. In single time there are many reactions occur therefore it is necessary to select or sort types of reaction occurring in human body. Biosensor is highly sensitive, selective and stable device with respect to biological reactions therefore fetching data for particular reaction is depend on the membrane from where the reaction is sieved out and significantly the transducer required to analyze that reaction.

III. AYURVEDA AND ENTREPRENEURSHIP

Incubation in biotech can also achieve by different therapeutics, Ayurveda medicinal therapies are much better as well as it is a concerning issue now a days in India. A series of antibiotics are not so successful due to their toxic effects on body. Depending on the dosage of ayurvedic medicines there are many compounds present in nature which are beneficial for human infrastructure, in India the research of Ayurveda is accomplished by “Central Council of Research in Ayurveda & Siddha” (CCRAS). [7] Ayurveda medicinal remedies came into existence when it was found that there were many plant and animals present on this earth which can be useful for human beings for treatment of different diseases. The remedies provided by traditional medicine systems played crucial role in developing modern drugs. In traditional medicine system, treatment began with known remedies followed by extraction, isolation and purification of pharmacologically active compounds. On the contrary modern drug design process begins by observing the root source of disease, determining its physiological state and then design a molecule to cure the ailment. In early 19th century, scientists began purifying the active extracts from medicinal plants (e.g., the isolation of morphine from the opium poppy). 19th century witnessed advancement in the field of pharmacology and instrumentation leading to the development of synthetic drugs based on natural products. In 1839, for example, salicylic acid was identified as the active component in various plants known for their pain-relieving qualities. Later salicylic acid was synthesized in 1853, it act as *lead* molecule eventually leading to the development of aspirin. It is estimated at present 25% of prescriptions are based on plant-derived ingredients and an even greater percentage are based on semi-synthetic or wholly synthetic ingredients originally isolated from plants. 75% to 90% of the rural population of the rest world still relies on herbal medicine as their only health care.

A. Applications of Ayurveda

Primary and Secondary metabolites of plants play a concerning role, the primary metabolite functionally modified for plants whereas secondary metabolites are produced in form of medicinal compounds or food derivatives.

<u>Scientific Name</u>	<u>Local Name</u>	<u>Applications</u>
Azadirachta indica	Neem	Antidiabetic, Anthelmintic
Aegle marmelos	Bael	GastroIntestinal issues
Aloe Vera	Ghritkumari	Antiirritant, Moisturiser
Tamarindus indica	Imli	as Poultice, in fever
Eclipta alba	Bhringraj	Dermatitis, Hairfall
Ocimum tenuiflorum	Tulsi	Antioxidants

Table 2. Medicinal Plants & their Applications

New Startups of biotech field can use such medicinal plants as LEAD molecule and can produce effective drugs. Innovation can be a part of medicinal biotech when such natural resources are used in drug designing or remedial therapies. On another track different animal components are used for the treatment of human diseases. The earliest use of animal as drug source dates back in the beginning of 20th century when Insulin derived from the pancreas of pigs and cows cured diabetes by reducing the amount of blood sugar. This invention made by Frederick B. and Charles Best. Since then, innovation was done with several hormones, amino acids, venoms, toxins as well as organs have been extracted and analyzed for pharmacodynamics study, it has been achieve with narrow spectrum due to ethical issues.

Animal	Parts used in medicine	Uses
Panthera tigris	Bones	Arthritis
Rhinoceros	Horn	Fever, convulsions, delirium
Bear	Bile	Liver ailments and headaches
Musk deer	Musk Gland	Skin infection, abdominal pain, perfume synthesis

Table 3. Animals with medical applications of their organs

As innovation leads to the incubation of business in the field of biotechnology which can be developed by utilizing natural resources having high therapeutic index. Most of the pharmaceutical companies have been modified into healthcare industries because now dependency on chemicals is enhancing diseases for human body; many immunological responses get decelerated or being reverse in form of autoimmune diseases. Advancement in “in vitro fertilization” is a big achievement for clinical biology but attached with many ethical issues and now it has been globalized. The market is demanding natural extracts for treatment or diagnosis of diseases. The scope of entrepreneurship in biotechnology is a novel track to explore business globally. Biotechnology is the key area to excel the rise of industrial section and also to make the agricultural section sustainable. The demand is that solutions are found for better health, environment, sanitation, exploitation and exploration of marine and aquatic resources by knowledge and good economy. It is the right time to design and develop products and processes by tapping the biodiversity and utility of ancient traditional knowledge for the holistic development through low invest affordable techniques. By appropriate information, communication challenges and obstacles in biotechnology frontier can be addressed by bringing incubation in innovative field by using the armature of research and development. Greater opportunities exist in the sector of biosciences/ biotechnology through entrepreneurship development among the youth and also through mentorship approach to accelerate start-up to promote Micro Small Medium Enterprises (MSME) through skill development approach. The discipline of biotechnology can survive only through interdisciplinary approach of large areas, including

bioinformatics, infrastructure and research costs including all engineering systems by investing in advance infrastructure to promote early start-up stage to the next level for growth and expansion. This needs to be largely demonstrated and validated by creating technological platform for production of high value of products through entrepreneurship development. The efforts are made also to support Mentorship program by supporting biotechnology infrastructure facilities, bio-incubators, bio-clusters and development with promotion of biotechnology entrepreneurship.

IV. ENTREPRENEURIAL COMPUTATIONAL BIOTECHNOLOGY

An “In Silico” branch of biotech called as Computational Biology is providing numerous applications to redefine, stimulate, evaluate, and simulate the therapies before clinical trial. Computational biology [8] is a fast track analysis with applications like Built in scalability, Ultra Throughput screening, Accuracy, Robustness, Flexible results which is novel now a days; its application is used in PCR, Gene cloning, ELISA, Protein Engineering, Gene sequencing and Biopsy. The ultimate goal of computational biotechnology is to analyze a living cell and its metabolic functions at the molecular stage. By observing rough molecular annotated sequences and raw structural data, computed biotech research can produce new imminent and initiate a tremendous perspective of the cell. The basic cause behind the purposes of a cell can be superiorly observed by studying sequential data because the stream of genetic information is defined by the “Central Dogma” of molecular biology in which DNA is transcribed to RNA, and translated to Proteins. Cellular functions are mainly performed by proteins whose capabilities are ultimately determined by their sequences. Therefore, solving functional problems using sequence and sometimes structural approaches has proved to be a fruitful endeavor. Computed technology is also helping numerous research institutes in saving analytical information not only in terms of completed research but also for ongoing research in form of databases like Genome database, Proteomics database etc. these innovative branches can be taken as reference for “Startups” of biotechnology.

V. CONCLUSION

Biotechnology is a fast growing sector. It offers vast scope for incubation, innovation and entrepreneurship. In India by

2020, biotechnical sector is likely to reach \$100 billion level with the present annual growth rate of around 20% and may accelerate its average growth rate to about 30%. Across the country more than 350 companies are working not only in biopharmaceuticals but also in agriculture sector, industrial biotechnology, bio-services and bioinformatics. The Incubation sectors of biotechnology can upgrade the share up to \$4.5 billion by applying the production techniques not only for therapies but in search of natural sustainable products. The demands have to be highly observed and validate by designing platform for delivery of high value products through entrepreneurship developments. Entrepreneurship in biotechnology does not include only high value Input but it focus on High Percentage of Yield. Biotechnical research demands a well furnished lab, with all proper facilities on a basic level if the research is parallel to Wet labs but it is also a breakthrough advancement that agricultural sector can also be adopted in the field of biotechnology. Sectors of life sciences can be signified in this branch to provide a technical as well as informative platform. Advancement in Up Stream processing and Down Stream Processing makes biotechnology an easy entrepreneurial platform which will also provide in installing a high level of industrial sector of this field

REFERENCES

- [1] Yoshikawa, A Guide to Free Radicals. Part 2. Sentan Igaku , Tokyo,1998
- [2] Arai, S. 1996 Studies on functional foods in Japan. Bioscience Biochem. 60: 9–15.
- [3] FICCI. Survey on challenges in food processing sector. Mumbai, India. 2010
- [4] Industrial biotechnology: tools and applications. Dec, 4(12) 2009.
- [5] Berg, Jeremy Mark; Tymoczko, John L.; Stryer, Lubert, Biochemistry 2010.
- [6] Turner, Anthony; Wilson, George; Kaube, Biosensors:Fundamental Applications 1987.
- [7] Meulenbeld, Gerrit J. A History of Indian Medical Literature. Groningen: Egbert F 1999.
- [8] Blaschke, C.,Hirschman, L., and Valencia, A. Information extraction in molecular biology. Bioinformatics 2002