

World History of Modern Biotechnology and its Applications

Raju P*

Department of Biotechnology, Godavari Institute of Engineering & Technology, Rajahmundry, Andhra Pradesh, India

***Corresponding author:** Raju P, Department of Biotechnology, Godavari Institute of Engineering & Technology, NH-16, Chaitanya Knowledge City, Rajahmundry, East Godavari, Andhra Pradesh 533296, India. Tel: +919441469706; E-mail: kingsolomon449@gmail.com

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Abstract

Biotechnology is the technological application which utilizes biological entities, living organisms or biological derivatives. The origin of biotechnology was not novel. The origin of biotechnology arose in ancient age. The ancient Egypt and China were the countries that used biotechnology in the form of food fermentation. The concept of biotechnology bound in a wide range of procedures for modifying living organisms based on the need of human activities. If it can be considered a trade, can be traced many centuries back, when wine making, production of vinegar and distilling were important human skills. The history of biotechnology as an industry begins in the early 19th century. Thousands of years back biotechnology was used by humankind in agriculture, food production and medicine. Modern technology of biotechnology was upgraded by using genetic engineering, cell and tissue culture techniques. The term modern biotechnology is adopted to refer biotechnological techniques. The new era of modern biotechnology came through the discovery of genes made of DNA. Manipulating of living things have been done by humans since the ancient age. Modern biotechnology recent developments are genetically modified plants and animals. New applications like genetic engineering and cell fusion are come under modern biotechnology.

Keywords: *Agriculture; Medicine; History; Biological systems; Environmental; Industrial; Pharmaceutical; Forensics*

Introduction

Throughout the history man has gained closer insight in to the natural things and continually striving to control the environment and the things which are having life to use them for his own needs. Different methods involving biological activities used anciently as traditionally. Cultivation of plants seems as biotechnological application, agriculture which was human derived used biotechnology to make the products. Agriculture has become the dominant system to produce food since Neolithic age by the early biotechnology. As we had many different types of crops to cultivate has increased to maintain. Early farmers discovered that specific organisms and their by-products having highest yields will produce more food for growing population. In the course of history of agriculture, farmers changed the genetics of their crops breed them with other plants in different environmental conditions-which was one of the forms of biotechnology [1-4]. In the modern age, people started baking cake and making wine with grapes at professional level. At the time of medieval association of merchants called guilds ruled over trading, many changes have occurred in technology and trade. In 17th century guilds system of trade got reduced due to changes in technology. Finally, industrial enterprises and large-scale production introduced.

After the discovery of Leeuwenhoek's microscope microorganisms could be seen, in 1865 only after 200 years, Pasteur has given scientific description for fermentation process [5-10]. At that time another achievement was done, at a session of the Hungarian Society of Natural Sciences on 13th November, 1861, a Hungarian chemist, M. Preysz, reported on a procedure for the preservation of wine by heat treatment [11-13]. His method was published, however, only in 1865, after Pasteur's famous publication, the discovery has not given legal priority. It is generally not known that the term "biotechnology" was first used by a Hungarian expert, K. Ereky, in his book published in 1919: "The Biotechnology of Meat, Fat, and Milk Production in the Agricultural Plant". Since ancient times Hungarians were interested in life related problems to resolve them. Humankind was interested in biology since the close relationship with nature and adopted the attitude of observing the field of science [14]. The American Chemical Society defines biotechnology as the application of biological organisms, systems, or processes by various industries to learn about the science of life and the improvement of the value of materials and organisms such as pharmaceuticals, crops, and livestock [15-17]. As per European Federation of Biotechnology, biotechnology is the integration of natural science and organisms, cells, parts thereof, and molecular analogues for products and services.

Basically biotechnology classified in to four major categories including crop production and agriculture, health care (medical), Environmental and industrial biotechnologies. A series of terms have coined for the identification of branches in biotechnology. For example:

- **Green biotechnology:** It is the technology applied to agricultural processes.
- **Red biotechnology:** It is the technology used in medical applications.
- **Blue biotechnology:** Blue biotechnology is the term used to describe aquatic and marine applications of biotechnology.
- **White biotechnology:** It is the technology used to industrial processes. All these derived technologies of biotechnology are come out and named as modern biotechnology. It is updated term for traditional biotechnology. Modern biotechnology is a term adopted by international convention to refer to biotechnological techniques for the manipulation of genetic material and the fusion of cells beyond normal breeding barriers and it also refers to the intentional modification and manipulations living organisms and organic matter [18-19].

The main techniques that gave birth to modern biotechnology are:

- **Genetic engineering:** This technique involves the change of nature of genetic matter of a living organism and to introduce in to host organism to alter the nature of host organism.
- **Biochemical engineering:** This technique involves the maintenance of sterile conditions of a desired microorganism in biotechnological processes to get the products like enzymes, hormones, antibiotics, vaccines and medicines. World has updated with new applications of biotechnology from traditional to modern biotechnology. All over the world some country has their history of maintaining biotechnological applications with updated Modern Biotechnology techniques.

Development of Biotechnology in Various Countries

Traditional background of modern biotechnology in Japan

Special contributions in bioindustry and applied microbiology in Japan can be considered as development of modern biotechnology in Japan. This review tries to summarize those original contributions in industrial sector with living organisms. In the first part we can see bioindustry and applied microbiology. In the second part recent progresses achieved in Biotechnology, secondary metabolites, genetic engineering, and screening of microbial diversity. There was a long tradition in fermentation technology to produce variety fermented food stuffs in Japan. Sake brewing process is the best one in which saccharification of rice starch by amylases from a fungus *Aspergillus oryzae* [20-24]. In the year 1894 the first industrial application of microbial enzymes was done by Japan scientist Jokichi Takamine in USA.

Development of modern biotechnology in India

In the year 1986, the Department of Biotechnology was established by the Ministry of Science and Technology for the development of biotechnology in India. It has become the new energy. The DBT has developed many centres in the country. Those centres are responsible for the making of new skilled persons in field of Biotechnology and to enlarge R&D in the private sector [25-28]. The Indian government has sponsored to research areas like genetic engineering, molecular biology, agricultural and medical sciences, plant and animal tissue culture, biofertilizers and biopesticides, environment, human genetics, microbial technology, and bioprocess engineering.

A good frame work was set up by the Indian government for Genetically Modified Crops and Recombinant DNA products for human health [29]. The Indian Government introduced new policies. In 2005 patent system has come in to force to convey the world that Indian industry supports the framework of new initiatives. Many states in India started new policies to develop the biotechnology industry as a whole.

Development of modern biotechnology in Austria

In the progress of biotechnology Austria has contributed a lot in the past. In 1846 from the manufacturing of Vienna process of baker's yeast it has raised to achieve many developments in 20th century [30-31]. For example, penicillin V, immune biotechnology, submerged vinegar process, biopulping, biocatalysis, mammalian cell technology, nanotechnology, biopolymers, and environmental biotechnology.

Evaluation of biotechnology in Hungary

First attempts in biotechnological production were done in consumer goods and food production. By using microbiology in pharmaceutical sector large production of vaccines were done in 1912. In the World War II from plant and animal origin medicinal products were made by the Hungarian pharmacist J. Kabay (1896-1936). After World War II development of fermentation technology was attained in Hungary itself. Vitamin B12 production first introduced in Hungary [32-37]. Hungarians were the first in the world to introduce beer brewing by the application of bacterial enzymes.

Biotechnology in Switzerland and Germany

If we go back to the fermentation processes of the roots of biotechnology starting from spontaneous reactions were made by simple means. By discovery of antibiotics bioprocess engineering has become compulsory. It further developed as well established technological application. In automation using of computers enhance the quality of bioprocesses [38-46]. Molecular biology, agriculture, genetic engineering applications got new developments in industrial sectors on both sides of Atlantic region. New advanced technology in Switzerland and Germany were established with the foundation of the European Federation of Biotechnology (EFB). In 1960s and 1970s a promised phase has given a way to a restrictive policy of insecurity demonstrates many European countries to new sciences like bioinformatics, genomics and proteomics [47-54].

Various Developmental Applications of Modern Biotechnology

To meet the needs of human beings', biotechnological applications were developed through various stages. Its development was based on observations and applications of observations. The main complication of biotechnology was increased due to upgradation of new technologies with in time. If we study the biotechnological developmental applications up to present age, we can divide them in three categories [55-61]. Ancient biotechnology applications, classical biotechnology applications and Modern biotechnology applications. In this review we will discuss more on modern biotechnological applications [62].

Second World War became as big hindrance to stop many scientific discoveries. At the end of the second world war many scientific discoveries were reported which leads to modern biotechnology. Proposed structure of double helix of DNA by Watson and Crick was reported in the year 1953, after that Jacob and Monod has given the concept of operon in the year 1961 and Kohler and Milestein in 1975 introduced cytoplasmic hybridization to produce monoclonal antibodies for the first time which ultimately leads to diagnostic revolution. These types of basic revolutionized discoveries became as basic applications for multiple modern biotechnological applications in many fields like medical, Healthcare, agricultural, plant, environmental, industrial, microbial, regenerative medicine, pharmaceutical and biosecurity [63-67].

Biotechnology in Healthcare

Healthcare biotechnology refers to a vaccine or diagnostic or medicinal that consists of or has been produced by living organisms through recombinant DNA technology [68]. This biotechnological application has major impact on patients to meet their needs. This application not only encompasses diagnostics and medicines by biotechnological process and also helps in gene, tissue and cell therapies.

Plant Biotechnology

Plant biotechnology is the technique which is used to manipulate the plants for specific needs or requirement. In basic agricultural practices we generally wait for natural production of offspring that will have basic quality. But in plant biotechnology we select the desired quality of a trait to clump with other quality to produce multiple qualitative traits in one offspring. For that plant biotechnology applies genetics, tissue culture, genetic engineering and transgenic crops [69-72]. Plant tissue culture is a part of plant biotechnology which is the collection of many techniques that is used to maintain and grow plant, plant cells, plant tissues under controlled sterile conditions over the nutrient medium.

Marine Biotechnology

Marine Biotechnology is one of the new field of study, emerged in the past few years. It began in 1998 when scientists from the Scripps Institution of Oceanography and various departments of the University of California, San Diego, came together and formed the Centre for Marine Biotechnology and Biomedicine [73-76]. The intention of Marine Biotechnology is to host scientific contributions in marine science that are based on the enormous biodiversity of marine ecosystems and the genetic uniqueness of marine organisms to develop useful products and applications.

Environmental Biotechnology

Environmental biotechnology is biotechnology that is applied to and used to study the natural environment. Environmental biotechnology could also imply that one tries to harness biological process for commercial uses and exploitation [77-81]. The International Society for Environmental Biotechnology defines environmental biotechnology as "the development, use and regulation of biological systems for remediation of contaminated environments land, air, water, for environment-friendly processes (green manufacturing technologies and sustainable development) [81-84].

Conclusion

The applications of biotechnology are so broad and the advantages are so effective, that virtually every industry is using this technology. Developments are underway in areas as diverse as pharmaceuticals, diagnostics, textiles, aquaculture, forestry, chemicals, household products, environmental clean-up, food processing and forensics to name a few. Biotechnology is enabling these industries to make new or better products, often with greater speed, efficiency and flexibility. Biotechnology holds significant promise to the future.

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