The Biotechnology's importance for society. Consumer's acceptance of biotechnological products.

Nastasia Belc

National Research & Development Institute for Food Bioresources, IBA Bucharest, Romania

Claudia Elena Moşoiu, Sorin Corneliu Iorga

National Research & Development Institute for Food Bioresources, IBA Bucharest, Romania

Abstract
Biotechnology is a very complex field which requires a wide multisciplinarity and that can be the one of the reliable ways to be used for developing several sectors such as: aqua- and agriculture, food industry, pharma industry, medical sector, veterinary medicine field or environment protection sector (forestry, soils, waters). Biotechnology has been used since ancient times for food production and preservation, but only in the last 2 centuries sufficient new knowledge has been accumulated in order to establish biotechnology as a specific field of expertise and competence. Green (agriculture), red (medical), white (industrial) and blue (water) biotechnologies are used for obtaining energetic, agricole, pharmaceutic, food and environmental protection products based on the microorganisms potential through genetic engineering techniques and their derivates such as microbian enzymes, by specialists having knowledge in chemistry, biochemistry, molecular biology, microbiology, informatics technology and nanotechnologies. The biotechnological products should be accepted by consumers (industrial, from agriculture or individuals) in order to be further marketed.

Keywords: *biotechnology, biotechnological products, cells, microorganisms, DNA, gene, acceptance*

Corresponding author: Nastasia Belc
Phone number: 0040745039655
E-mail address: nastasia.belc@bioresurse.ro

I. SHORT HISTORY OF BIOTECHNOLOGY

The first mention of food biotechnology can be traced back to 4000-2000 BC to the fermentative processes used for obtaining food, such as: bread and beer in Egypt and Mesopotamia, cheese and wine in Sumeria, China and Egypt (Ray, & Joshi, 2014). The first antibiotic was used in China around 500 BC. It was obtained from moulds soy milk and it was used for burn treatment. The first pesticide was discovered in 100 AC and it was used for chrysanthemum protection.

Much later, between 1590 and 1675, microscope was invented by Jansen; cells were discovered by Hooke and bacteria by Leeuwenhoek. After more than 200 years, in 1830, proteins were discovered and the first enzyme was isolated. Schleiden and Schwann found that „all organisms are made by cells" and Wirchow discovered that „each cell is born from a cell" (Vasil, 2008).

Discoveries in biotechnology continue in the 19th century with the following pioneers: Pasteur who uncovered that fermentation is caused by microorganisms; Charles Darwin with the theory of evolution by natural selection; Gregor Mendel, considered the founder of modern genetics, formulated the laws of heredity and Alexander Fleming who discovered penicillin as an antibiotic. Also, in the same century, for the first time, in order to improve the cotton yield, cotton was inoculated with a nitrogen-fixing bacteria and W. Beal produces at a laboratory scale the first experimental corn hybrid. The U.S. Congress passes „The Law for recording the plants" (Plant Patent Act) that made it possible to improve the patenting of products, which lead to the arrival of maize hybrids in the U.S. market (Dan, 2001).

In the 20th century, during the First World War, the fermentation processes were being used to produce acetone from starch and solvents for paintings, but, at the same time, biotechniques were being directed to the pharmaceuticals production. Since 1942, industrial penicillin is produced in microbial culture. In 1944, Avery and his team proved that the carrier of genetic information is DNA, which was synthesized for the first time in 1958.

The Cold War period was dominated by the use of microorganisms in the production of antibiotics and fermentation processes in agriculture, food processing, and production of energy, insulin and immune drugs.

In 1961, the US Department of Agriculture, registered the first biopesticide (*Bacillus thuringiensis* Bt), and in 1963 started „the green revolution" in agriculture, promoted by Norman Borlaug, with new varieties of wheat leading to an increase of 70% in production. By doing this, Borlaug was awarded the Nobel Prize for Peace in 1970 (Hesser, 2006). Also, in 1970, the first restriction enzyme was discovered, and in 1971 the first complete synthesis of a gene was bioengineered. DNA ligase enzyme, which binds the DNA fragments, is used for the first time in 1972 to obtain the first molecule of DNA from two recombined viruses (Lehnman, 1974).

In 1976, the first regulation regarding the recombined DNA experiments is elaborated and leads to the discovery of the base pair sequences of a specific gene (A, C, T, G). In 1980, Exxon recorded microorganisms that breakdown oil and Berg, Gilbert and Sanger received the Nobel Prize for Chemistry for creating the first artificial recombined DNA molecules. In 1982, the first DNA recombined vaccine is obtained for domestic animals and the first „biotech" drug (human insulin produced from genetically modified bacteria) was approved by the Food and Drug Administration, USA. In 1983, a whole plant (*Petunia*) is obtained for the first time through biotechnology, demonstrating thus that GM plants transmit new characters to their descendants (i.e. color).

1986 was rich with two very important „biotech" products: first human vaccine for the prevention of hepatitis B and interferon for treating cancer.

In 1987, testing of genetically modified crop plants in the field is approved: tomato and potato varieties resistant to viruses. In 1989, the first approval for field trials of GM cotton resistant to attacks by insects (Bt cotton) is obtained and the project „Plant Genome" starts.

In 1990, Bt maize, genetically modified yeast, genetically modified trout and a substance obtained by „biotech" techniques, chymosin enzyme for the manufacture of cheese, are obtained.

In 1993, The Biotechnology Industry Organization (BIO) was created. In the same period, FDA approves the use of bovine somatotropin for increasing milk production in cows.

In 1996-1997 the first genetically modified crop plants to resist insect attacks (Knockout Maize and Bollgard Cotton) and weeds (Roundup Ready Soybean) were marketed (de Maagd, Bosch, & Stiekema, 1999). Around the same period, in Scotland, the first animal clone, Dolly sheep, is created.

Biotech plants are cultivated worldwide on nearly 1 million hectares: Argentina, Australia, Canada, China, Mexico and the US. In 1998, five Asian countries formed a consortium in order to produce a virus-resistant papaya.

In 2000 the first complete map of a plant genome was developed: *Arabidopsis thaliana*, and in 2001 the first genome map of cultivated plants is completed: rice.

Since the beginning, biotechnology linked industry to agriculture. Also, it represents an area of convergence for genetic engineering in the form of cloning, detecting the level of pesticides, herbicides, plant and animal toxins, methods of DNA recombined with chemistry, physics and biology.

In food industry, the single-cell protein (SCP) includes dry cells of microorganisms (yeasts, molds, algae and bacteria) that grow on molasses, methane, methanol, ethanol, whey, starch, cassava and other wastes and residues (Becker, 2007). SCP can solve some of the problems of the world concerning food security. Mycoproteins and their derivatives, products of biotechnology, are considered novel foods because they are the most economical way to convert any excess of carbohydrates into a higher nutritional value food. The amino acids' content of mycoproteins is similar to the F.A.O. reference protein (Moo-Young, Chisti, & Vlach, 1993).

In the same area, vitamins and food flavorings represent another area of interest in biotechnology. Vitamin B12 is the product of the metabolism of some actinomycetes (*S. olivaceus*, etc.) or bacteria (*Propionibacterium shermani*, *P. technicum* etc.). Green-blue algaes are sources of vitamin E.

II. THE IMPORTANCE OF BIOTECHNOLOGY FOR SOCIETY

People need an unpolluted environment, healthy foods, an adequate income from various activities etc. All of these needs have mobilized agriculture and industry to develop new ways of improving people's lives (Costin, Bahrim, Borda, & Curic, 2005). Both within the economy, as well as outside it, researchers are trying to find solutions to improve quality of life. One of the newest ways and with an enormous potential for development is „biotechnology".

Progresses in biotechnology have continuously improved quality of life. New generations can expect to live longer and healthier than previous generations. Issues relating to health, age, food and environment have a biological component and are based on new knowledge from biotechnology (Banu, 2010).

Biotechnology has been defined by FAO/WHO in 1990, as „the integration of natural and engineering sciences, in order to use the organisms, cells, and derivatives thereof for the manufacture of products and services".

Until the '70s, the concept of biotechnology was still scarcely used, scientific and technological activities in this sector being known as belonging to „industrial microbiology", which referred to the industrial use of the productive potential of the microorganisms. Scientific revolution in biology has led to the development and evolution of genetic engineering, outlining two main steps:

- the classical biotechnology (traditional), as a substitute, replacement of modern industrial microbiology,
- Modern biotechnology (new biotechnology), which is based on genetic engineering (Banu, 2010).

Meanwhile, the potential benefits and implications of biotechnology on society and the environment have lead to intense public debates. Consequently, since the European Council in Lisbon in 2000, the European Union has set a new target for the next decades: to be a sustainable economy, with the most competitive and dynamic knowledge and to ensure jobs, more and better social cohesion.

In the European Council report (Stockholm 2001), according to the Lisbon strategy, the Commission has reformulated the potential economic, social and environmental aspects of life sciences and biotechnology, and, subsequently, its strategy and long-term growth for Europe. Moreover, the continuation of this strategy was announced for after 2010. Therefore, biotechnology has entered in a stage of exponential growth, opening up a vast potential for economic changes towards sustainable development and improved quality of life (McNamee, & Ledley, 2012).

Research based on new knowledge in biotechnology creates an opportunity to provide new products and services. Most importantly, this opportunity can be used only if there is broad public support, the consumer’s acceptance (Shetty, Paliyath, Pometto, & Levin, 2006). An overall picture of public biotechnology research showed that development and biotechnology applications aimed at increasing the quality of life of people, animals and the quality of the environment (including biodiversity).

The industrial biotechnology is close to reaching a critical mass of maturity and convergence (Banu, 2010). The convergence of biotechnology, nanotechnology and information technology will ensure progress rates and unprecedented expansion, if public acceptance of biotechnology will prevail (Mittal, 1992).

In the long term, biotechnology will have a profound impact on our perceptions of health and age; it will increase our capacity to protect the planet and material science and bioengineering with an important impact on the environment and on the entire world economy.

It will be a new era of self-directed evolution; humanity will create new molecules, metabolic pathways, tissues, organ systems and even life forms (Niculiţă, Popa & Belc 2006).

Therapies in humans (red biotechnology) will take into account the molecular breeding, pharmacogenomics and cell strains technologies that will allow the development of personalized therapies (Torrance, 2010). Molecular breeding will produce a change in drug development with products developed based on evolution diversity to meet the market requirements. Therapies based on pharmacogenomics will provide very high specificity for patients and embryonic cell technologies, combined with retroviral therapy that will soon allow the replacement of old or ill organs and, perhaps, even slowdown the molecular clock.

Prevention, rapid diagnosis, treatment and cure of diseases depend on the biotechnological products: antibiotics, enzymes, vaccines, hormones, therapeutic proteins, immune products, vitamins and drugs.

The use of microbial metabolites replaces increasingly more use of the plant or animal tissues. Use of *Genetically Modified Organisms* in order to obtain insulin, interferon, thrombolytic and fibrinolytic enzymes, growth hormones, neuroactive peptides and regulators of the respiratory system are the current practices with many possibilities of development (Houdebine, 2009).

Through agricultural biotechnology (green biotechnology), more resistant plant varieties of crops will be obtained (Wenzel, 2006). Yields will be substantially more nutritive.

Genetic manipulations meant to improve varieties, obtaining insecticides, herbicides, fungicides less toxic to humans and less polluting the environment, treatment of diseases and preservation products represent products and technologies that biotechnology can provide.

Regarding breeding, biotechnology offers solutions in the prevention and diagnosis of diseases, in animal nutrition and treating diseases (Niculiţă, Popa, Belc, & Miteluţ, 2007).

Biocatalytic production processes within the industrial biotechnology (white biotechnology) will allow full biological production of consumer goods such as clothing, plastics and building materials (Shetty, Paliyath, Pometto, & Levin, 2006). Biocatalytic approaches will support the assembly of complex products, such as devices and even cars.

The food industry, energy, mining, detergents, leather and textile based on biotechnology products (enzymes, amino acids, aromatic compounds, colorants, polysaccharides, organic acids, etc.) and even biotechnology (fermentation, biosynthesis).

Application of biotechnology in remediation and preserve the environment areas are already being used, but there are applications, not yet marketed with a significant potential for capitalizing such as: degradation of pollutants from water by microorganisms, the elimination of heavy metals from soil, the breakdown of fats, degradation of pesticides and herbicides very toxic, etc.

Fuel made from renewable green biomass, bioelectronics developed, especially in getting biosensor and biochip sites that use enzymes and proteins sensitive or microorganisms genetically constitutes only the beginning of industries and technologies of the future that will be able to replace many human activities (Stein, & Rodríguez-Cerezo, 2010).

Biotechnology will provide a safer and more sustainable production environment compared to conventional technologies (Green, 1992).

Bioinformatics with the integration of computer science and biotechnology will replace chips based on silicon with much faster living computers. Bioinformatics will allow for more reliable computers, information will be processed at nano-scale and processes will be distributed in everyday tools. Remarkable progress in bioinformatics, the computer aided management systems of bioprocesses and those of genomics studies and protein engineering will lead also to an unprecedented development of the field (Morey, Fernández-Marmiesse, Castiñeiras, Fraga, Couce, & Cocho, 2013).

Materials science will end developing on the biological basis and by production of materials, ranging from more resistant fibers, lightweight and fine to the adhesives based substance made from insects.

Hybrid that combines biological and nanotech components will be increasingly used in applications such as nano-motors, storage devices and memory circuit's sensory transduction. This is the role of bioengineering.

Environmental Bioengineering will be involved in the development of sustainable manufacturing technologies that reduce and/or remedy environmental damage (Wang, Tay, Tay, & Hung, 2010). Microorganisms will be used for purifying contaminated soil, industrial effluent, water and petrochemical spills and contaminated air. Developing strong synergistic technologies such as high resolution image, genomics, proteomics and molecular improvement will boost the biotech industry to unprecedented rates of progress and expansion.

Areas of biotechnology: new drugs, new materials, agricultural biotechnology, industrial production biological controlled and bioinformatics will be mature and convergent. Long-term future of biotechnology will be determined by two fundamental determinants: one technological and one social.

The speed and degree of integration of technology among various sectors of biotechnology, as well as integration nanotech biotechnology and informational technology will be crucial.

Biotechnology development, new acquired knowledge and public acceptance will shape both market demand, and public policy.

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