Informative Article

Improving quality of our life through biotechnology

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Introduction:

Biotechnology is any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use. It applies the knowledge of biology to enhance and improve the environment, health, and food supply. Using biotechnology, scientists work to develop environment-friendly alternatives to fossil fuels and plastics; new medicines, vaccines and disease diagnostic tools and higher yielding and more nutrient-rich crop plants (Miller, 1991). Biotechnology affects every part of our lives in the 21st Century. Some technologies used for human welfare are:

Bioprocessing:

The use of bacteria, yeast, mammalian cells and/or enzymes to manufacture products. Large scale fermentation and cell cultures carried out in huge bioreactors manufacture useful products like Insulin, vaccines, vitamins, antibiotics, amino acids etc (Mudgett, 1996).

Monoclonal antibodies (MCAb):

Our immune system makes proteins called antibodies which are produced by cells called B-lymphocytes. β-lymphocytes produce antibodies when our immune system detects a foreign substance that has invaded our body. Monoclonal antibodies (MCAb) for medicine are produced by cloning a single cell. Therapeutically, MCAb are used for Home Pregnancy tests, to diagnose infectious diseases such as streptococcal infection and gonorrhoea; to detect cancer(they bind to tumour cells) and to detect diseases in plants and animals, food contaminants and environmental pollutants (Hubbard, 1983).

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Cell culture technologies:

Plant cell culture in which growing cells in containers or large bioreactors are achieved. Plant cell cultures are used to grow genetically engineered plants that contain useful traits, such as resistance to insect pests (Hansen & Wright, 1999).

Animal Cell Culture is used for breeding livestock. Bovine zygotes from genetically superior bull and cows can be produced in large numbers to be implanted into surrogate cows (MacDonald, 1996).

Human Embryonic Stem Cell (ESC) are undifferentiated cells that have the potential to develop into any cell in the human body. One source of ESC is the inner cell mass of the human blastocyst. Other sources of ESC are being discovered and developed (Wilmut et al, 1997).

Tissue engineering technology:

This is a combination of cell biology and materials science where semi synthetic tissues in the laboratory are created using natural collagen and synthetic polymers to produce artificial skin. The goal is to create complex organs as replacement for diseased or injured organs (Mironov et al., 2003).

Genetic engineering technology:

It makes the use of recombinant DNA technology that is the recombining of genetic material from two different sources. It is the next step, after selective breeding, in changing the genetic makeup of organisms (Schmidt, 1994). Products of genetic engineering are: a) Transgenic bacteria – bacteria that produces human insulin; b) Transgenic plants – plants that glow in the dark (firefly gene), plants that are resistant to disease, to frost; Transgenic animal – mice with human genes; animal with extra copies of growth hormone genes, that grows faster and produces leaner meat and chicken resistant to bacteria that causes food poisoning (Hammer et al, 1985).

Bioinformatics technology:

Use and organization of information about biology. This is an interface of computer science, mathematics and molecular biology. Objective is to use database management to map and compare genomes, determine protein structure, design drugs, identify genes, etc (Forslund & Sonnhammer, 2008).

DNA chip technology:

This is a combination of the semiconductor industry and molecular biology which consists of a tagged DNA on a microchip that can be read using lasers, computers and microscopes and allows tens of thousands of gene to be analyzed on a single microchip and used to detect mutations and diagnose genetic diseases (Lemieux et al, 1998).

In the coming years, most of the commercial application of biotechnology will be in four markets: Medical, Agricultural, Environmental and Industrial Systems. Though Medical and Agricultural areas are more relevant from the international market point of view, in the Indian context, environment and industrial products are also likely to present immense opportunities in the short term - both for traditional and modern Biotechnology products.

Medical Biotechnology:

To detect and diagnose many diseases and medical conditions more quickly and with greater accuracy, designer drugs, gene therapy to correct genetic disease, cell therapy to produce replacement tissues and organs, antibiotics, cancer therapy to suppress tumour genes and prevent or cure cancer, design and production of vaccines (Feber, 2001). Vaccine delivery systems (goats that produce milk with a malaria antigen in it). Vaccines have also made an important effort in helping to control disease epidemics. Forensics: DNA fingerprinting allows for the identification of individuals by analyzing section of DNA that varies widely from one individual to another (Findley et al, 1997). Human Genetics: Stem cell research has proven potential to help over 10 million people with osteoporosis, 43 million arthritis sufferers, and 250,000 people paralyzed by spinal cord injuries (Gardner, 2002).

Agricultural Biotechnology:

It is the single largest influence on farming since the cultivator ; increased yields per plant, increased resiliency to chemicals such as pesticides, easier to grow economic gains for farmers, ending world hunger, biopesticides and biofertilisers. Today, there are over 200 million acres of crops in over 17 countries that have been improved by biotechnology. Designer plants – genetically modified organisms (GMO) with inserted genes. Genetically modified plants can be resistant to disease, frost, and insects. GMO can be a factory for pharmaceuticals: tobacco plant that produces haemoglobin. Plants that yield a healthier and higher than normal crop to improve our food supply, animal feeds / supplements from agricultural products and natural products in healthcare (Potrykus, 1990).

Animal Biotechnology:

Livestock that is engineered to resist disease -no more mad cow disease, cattle that produces human pharmaceutical products and cattle with increased muscle mass and less fat for healthier food supply. Flavours / fine chemicals / amino acids / nutrient supplements from animal waste (Schwerin et al, 1995).

Environmental Biotechnology:

Cleaning up pollution through bioremediation: the use of microbes to digest and convert unwanted waste material into harmless substances, cleaning oil spills using living organism, helping the environment: burn cleaner, made less toxic, biodegradable, recyclable and low to zero greenhouse gas emissions, reduced use of chemicals/ pesticides, reduced ground water contamination, reclaiming of polluted or salt-affected land, increased agricultural productivity reducing the need for land clearing, thus protecting biodiversity, detection, removal and treatment of toxins in water, air, food and soil, and conversion of waste into energy. The use of biotechnology has the potential for both positive and negative impacts on the environment. Biotechnology can be used to support work on recovering endangered species. (Miller, 1991).

Industrial Biotechnology:

Production of antibiotics, vitamins, detergents, new textile fibres, biodegradable plastics, biomass fuels: biodiesel and bioethanol, biorefineries: lower emissions, economical benefits: cheaper

production and government incentives (Lipinsky, 1981). Recombinant DNA technology is used for producing various compounds in micro organisms. It also plays an important role in fermentation processes and has applications from food area to development of various products (Bristow, 1993).

Conclusion:

Biotechnology has grown more in the last 15 years than almost any other field of science. This growth is due to the fact that it has helped benefit virtually every aspect of our lives. Its benefits may potentially one day be able to reach out to help virtually any person, in any profession, in a positive way. Although there are some clear concerns with the different aspects of biotechnology, government regulations have helped make sure that the technologies we use are safe and have constructive affects on us and our environment and that the positive benefits we gain from biotechnology far outweigh any moral and social implications.

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