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Biosafety and Biosecurity Issues in Biotechnology Research

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Biotechnology

Biotechnology is broadly as the application of and engineering principles to produce valuable substances by deploying biological agents. Here, the biological agents are not only limited to microorganisms but animals and plants are also being used for the purpose. substances referred here are renewable materials produced by the biological agents for food, feed, beverages, pharmaceuticals and industrial uses. Today, scientists can isolate any gene of interest from any organism or part thereof and incorporate it into a small self-replicating extrachromosomal genetic element for multiplication as well as expression of the gene. recombinant DNA molecule thus produced can be introduced into host cells such as bacteria or yeast to grow large vats or fermenters full of the recombinant organism. have empowered scientists to tailor-make genes and have they expressed in living organism to produce the desirable product [1].

Some of the achievements of current biotechnology research include production of life-saving drugs in microorganisms, development of the golden rice and the iron-rich rice, biofertilizers, biopesticides, use of plants and animals as bioreactors for producing enzymes and chemicals for industrial uses, production of biodegradable plastics, biosensors, superbug etc. for tackling some of the environmental problems. biotechnological tools and techniques, if properly integrated with other technologies, provide tremendous opportunities for sustainable developments in several areas of human endeavors.

Achievements of Biotechnology

Since the discovery of recombinant DNA technology, newer techniques and applications have been developed that are mankind in the areas of agriculture, medicine, environment, industry and forensic science. Industrial biotechnology is an expanding that includes production of enzymes for a variety of industrial uses and deploying microorganisms and plants for treatment of wastes and abatement of pollutions. Bacterial bioleaching (using bacteria to extract metals from ores or mine wastes) is another growing sector of mining industry. Screening the microbial diversity of various environments (e.g. the oceans, hot springs, deserts, glaciers etc.) and deciphering their genetic information aimed at and utilization of microorganisms in the manufacture of drugs, enzymes and a wide range of bioactive compounds provide tremendous potential applications of industrial biotechnology. Fungus is used in bio pulping to convert wood-chips into pulp in paper industry.

In the health industry, biotechnology is used to produce more and vaccines, antibiotics and other therapeutics. It is used to develop diagnostic tools for identifying heritable diseases. DNA is now successfully used to diagnose hereditary diseases to predict the chance of an individual inheriting a disease from an parent. It can also be used to detect the predisposition of an individual to a cancer, or chromosomal aberrations. Biotechnology has produced more than 160 drugs and vaccines and there are about 370 pharmaceutical products and vaccines currently under clinical trials targeting more than 200 diseases, including various cancers, heart disease, diabetes, multiple sclerosis, AIDS and arthritis. gene therapy, scientists are targeting to cure genetic diseases by replacing defective genes with healthy ones.

Environmental biotechnology aims at optimal use of the nature, in the form of plants, animals, bacteria, fungi and algae to produce renewable energy, food and nutrients in a synergistic integrated cycle where the waste of one process becomes the feedstock for another. It is mainly concerned with the application of biotechnology in the environmental protection, since the rapid industrialization, urbanization and other developments have threatened clean environment and depleted natural resources. Developing and using alternative fuels that burn cleaner would minimize air pollutions and improve air quality for breathing. Oil spills clean up in the oceans can be managed with the microbes isolated from oil wells which can degrade oil or use it as energy source. Biosensors have become crucial for monitoring environmental pollutions which exploit biological to produce signals that can be used to measure pollution level. Biosensors for heavy metals and pesticides have been successfully designed [2,3].

Forensic biotechnology is proving to be vital for detection and investigation of crime, administration of justice, providing crucial information about the evidences found at crime scene. Analysis of DNA samples allows precise to be made from very tiny bits of evidence collected at the crime scene. has really brought a revolution in the era of forensic science. Today, several PCR-based DNA systems are used to relate the evidence collected at the crime scene with the suspect. In judicial system, forensic experts use DNA to identify suspects in criminal cases especially where body and other particles like hair and skin samples can be retrieved.

Agricultural biotechnology enables gene transfer across the natural barriers, thus creating a universal gene pool. Animal biotechnology has been used to hasten animal growth, enhanced reproductive capacity, improved animal health and several new animal products. Biotechnology is also being used to develop low-cost disease-free planting materials for crops such as cassava, banana, potato etc. and is creating new tools for diagnosis and treatment of plant and animal diseases. Plant genetic engineering promises to contribute in agriculture, energy and health sectors, and environmental stewardship. However, like any other powerful technology, biotechnology also requires to be handled with utmost care and safety. With the increasing applications of biotechnology in almost all the

areas of human endeavours, there is a crucial need to ensure that the technology is used judiciously.

Biosafety

Biosafety refers to containment principles, technologies and practices that are implemented to prevent unintentional exposure to pathogens and toxins, or their accidental release into the environment. Biosafety is not only a personal requirement but essential collective to ensure biological safety for a clean and safe environment [1]. In the last few decades, biotechnology research has resulted into the development and release of several GMOs for commercial uses [4]. Releasing GMOs into the environment may have direct or indirect including or gene-transfer to wild relatives, trait on non-target species, pest resistance and other unintended One of the most environmental of GM crops is the drastic reduction in pesticide use in agriculture. Despite their potential, there is a multitude of concerns about the impact of GM crops on the environment. With the increasing number of countries adopting molecular tools and techniques in their life science research and development activities, the biosafety issues are gaining importance to ensure biological safety for the public and the environment. Recognizing the need of biosafety in GE research and development activities, an international multilateral agreement on biosafety "the Cartagena Protocol on Biosafety (CPB)" has been adopted by many countries world over.

Biosecurity

term biosecurity is more complex as it can have meanings in contexts. According to the WHO guidance [5], biosecurity refers to the mechanisms to establish and maintain security and oversight of pathogenic microorganisms, toxins and relevant resources. Laboratory biosecurity describes protection, control and accountability for valuable biological materials within the laboratory, in order to prevent their unauthorized access, loss, misuse, diversion or intentional release. While biosafety protects people from harmful germs, biomolecules or chemicals, biosecurity protects such materials from people. biosecurity concepts from biosafety concepts. approaches used to achieve them are similar or mutually reinforcing, but in some cases they may have For example, in the transportation of dangerous pathogens, biosafety recommends clear labeling of the material during transport, but from a biosecurity perspective, labeling of the material during transport may increase the risk of or misuse.

The Issues

With the increasing emphasis on adoption of GE technology, biosafety issues are gaining importance to ensure safety of the public and the environment. has been increasing awareness among the researchers, producers and users of GMOs, administrators, policy makers, environmentalists and general public about biosafety. many countries have put into place regulatory policies and regulatory bodies for research and development of GMOs, however strict compliance to biosafety guidelines is still required in many developing countries.

there are several technical issues of releasing GMOs in the environmental for commercial uses [4], safety of the laboratory workers, consumers and the environment as a whole is the biggest issue. As per a report, containment facility in the laboratories across the region failed to live up to the term [6]. Biosafety and biosecurity issues became much stricter 2001, when anthrax attacks in the United States raised the spectra of bioterrorism using laboratory-prepared pathogens. Unfortunately, stringent biosafety and biosecurity rules are still impractical in many countries, where researchers need to handle infectious agents such as anthrax and plague to protect public health, but lack the proper infrastructure.

It is clear now that modern biotechnology promises to enhance the quality of human life, if used judiciously. On the other hand, if used haphazardly and carelessly, it may have negative impacts as well. Biosecurity is the need of the day, as bioterrorism is another associated concerns emerging rapidly and need to be taken care in the interest of the sustainable research and development as well as for healthy and safe environment.

views expressed here are those of the author only. may not necessarily be the views of the institution/organization the author is associated with.

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