

The Genetic Revolution Applied Biochemistry in Genetic Engineering and GMOs

Rahman Kuruva*

Department of Biotechnology, Islamic University, Kushtia, Bangladesh

Corresponding author: Rahman Kuruva, Department of Biotechnology, Islamic University, Kushtia, Bangladesh, E-mail: kuruvar@163.com

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Description

The advent of genetic engineering has ushered in a new era in agriculture, medicine and biotechnology, fundamentally altering how we interact with and manipulate living organisms. This can involve the addition, removal, or alteration of genetic material to achieve desired traits. The tools of genetic engineering rely heavily on principles of biochemistry, including DNA manipulation, gene cloning and protein expression. This essay explores the role of applied biochemistry in genetic engineering and the development of Genetically Modified Organisms (GMOs), examining their implications for agriculture, medicine and environmental sustainability. The genetic revolution, driven by applied biochemistry, has fundamentally transformed our approach to agriculture, medicine and biotechnology.

Applied biochemistry in GMOs

One of the most famous examples of GMOs in agriculture is the creation of crops that produce their own insecticides. For instance, the introduction of the *Bacillus thuringiensis* (Bt) gene into crops such as cotton and corn enables these plants to produce proteins that are toxic to specific pests. This bio pesticide approach reduces the need for chemical pesticides, leading to a decrease in agricultural runoff and environmental impact. Another common application of genetic engineering is developing crops that are resistant to herbicides. By introducing specific genes, scientists can create crops that tolerate certain herbicides while allowing farmers to control weeds without harming the crop. This not only improves crop yields but also promotes more sustainable farming practices. This bio fortification aims to address vitamin A deficiency, which affects millions of people, particularly in developing countries. By improving the nutritional profile of staple crops, applied biochemistry contributes to global food security and public health. While the benefits of genetic engineering and GMOs are significant, ethical considerations and public perception pose challenges. Concerns about the safety of GMOs for human consumption and their impact on biodiversity and ecosystems have fueled debates around their use. Restriction enzymes is an enzymes cut DNA at specific sequences, allowing scientists to isolate and manipulate particular genes. DNA Ligase is the enzyme joins DNA fragments together, facilitating the insertion of new genes into a target organism's genome. CRISPR-Cas9 a

revolutionary gene-editing tool that allows for precise modifications in the DNA sequence, making it possible to knock out, insert, or replace genes with unprecedented accuracy. These technologies have enabled researchers to create GMOs, organisms that have been genetically modified to exhibit traits not found in their natural counterparts.

Medical biotechnology

The implications of genetic engineering extend beyond agriculture into the area of medicine. Applied biochemistry has enabled significant advancements in the development of therapeutics, vaccines and gene therapies. Recombinant DNA technology allows for the production of proteins that are essential for therapeutic applications. By inserting the human insulin gene into bacteria, scientists can produce large quantities of insulin that are identical to that produced by the human pancreas. Gene therapy is an innovative approach that aims to treat genetic disorders by introducing, removing, or altering genes within a patient's cells. Techniques such as CRISPR-Cas9 enable precise editing of genes associated with diseases, offering hope for conditions that were previously deemed untreatable. For instance, advancements in gene therapy have shown potential in treating disorders like cystic fibrosis, hemophilia and certain types of cancer. The development of genetically engineered vaccines has revolutionized preventive medicine. For instance, the production of recombinant vaccines, such as the hepatitis B vaccine, involves inserting viral genes into yeast or bacteria to produce antigens that stimulate an immune response. These vaccines are often safer and more effective than traditional ones, contributing to global public health initiatives. Emerging technologies and methodologies are poised to further enhance our ability to modify organisms for beneficial purposes. New techniques such as base editing and prime editing allow for even more precise modifications of genetic material. These advancements can potentially reduce off-target effects and expand the possibilities for genetic improvements in both crops and livestock. With climate change posing significant challenges to global agriculture, genetic engineering can play a pivotal role in developing crops that are more resilient to environmental stressors such as drought, salinity and extreme temperatures. By enhancing stress tolerance through genetic modification, we can secure food supplies in the face of a changing climate. In medicine, the future of genetic engineering promises exciting

customize treatments based on an individual's genetic profile. As our understanding of genomics deepens, we may see the emergence of highly targeted therapies that are more effective and have fewer side effects.