NCERT Class 12 Biology Exercise Solutions

Chapter 10 – Biotechnology and Its Applications

1. Crystals of Bt toxin produced by some bacteria do not kill the bacteria themselves because –

(a) bacteria are resistant to the toxin.

(b) the toxin is immature.

(c) the toxin is inactive.

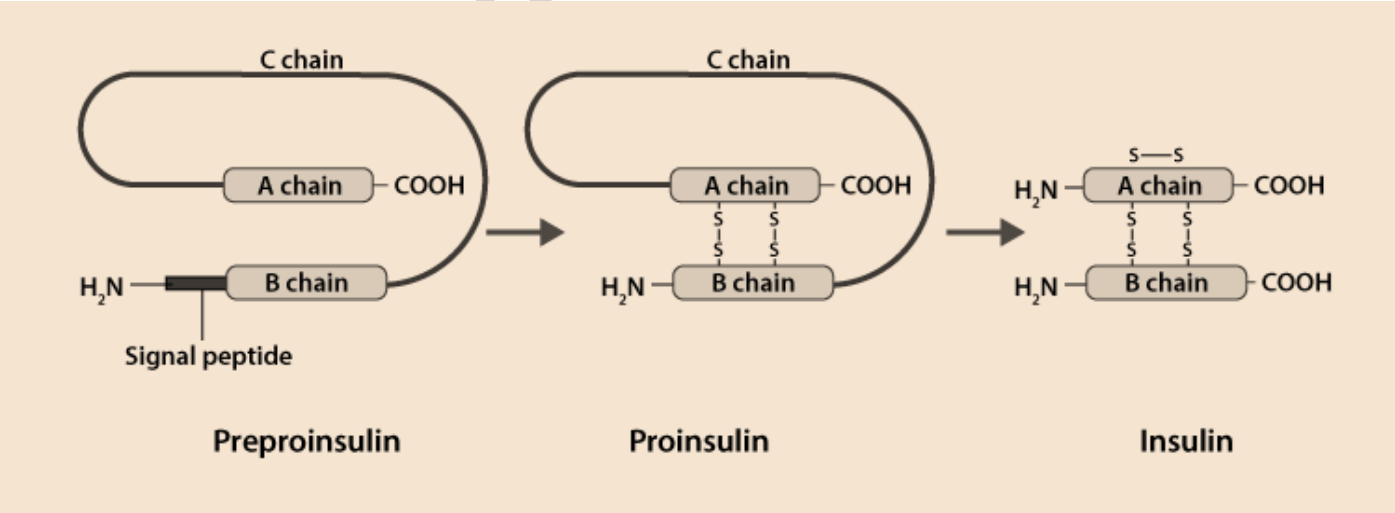
(d) bacteria enclose toxins in a special sac.

Ans: (c) the toxin is inactive.

Bacteria contain toxins in an inactive state called protoxin, which becomes active upon entering an insect's body.

2. What are transgenic bacteria? Illustrate using any one example.

Ans: Transgenic bacteria are genetically modified organisms that have a foreign gene intentionally inserted into their genome. This manipulation allows them to express a specific gene and produce various commercially significant products. For instance, E.coli, a type of transgenic bacteria, contains two DNA sequences in its plasmid that correspond to the A and B chains of human insulin. These sequences are introduced into the bacterium to generate the respective chains of human insulin. As a result, the bacterium becomes transgenic and starts producing the chains of human insulin. After a certain period, these chains are extracted from E.coli and combined to create human insulin.



3. Compare and contrast the advantages and disadvantages of the production of genetically modified crops.

Ans: The advantages of genetically modified crops include enhancing tolerance to abiotic stresses like cold, drought, heat, and salt, creating customized plants for various industries, increasing pest resistance to

boost crop productivity, improving nutritional quality, reducing post-harvest losses, and preventing early soil fertility depletion.

On the other hand, disadvantages of genetically modified crops involve the risk of introducing harmful traits through unintended combinations, the potential emergence of super weeds, low reproductive rates, the production of chemicals that may be harmful to human health, the presence of allergens and antibiotic resistance markers, and the negative impact on native biodiversity due to genetic pollution in wild crop relatives. For example, the use of Bt toxin to reduce pesticide amounts can inadvertently harm insect pollinators like honey bees if the toxin is expressed in pollen, affecting pollination.

4. What are Cry proteins? Name an organism that produces it. How has man exploited this protein to his benefit?

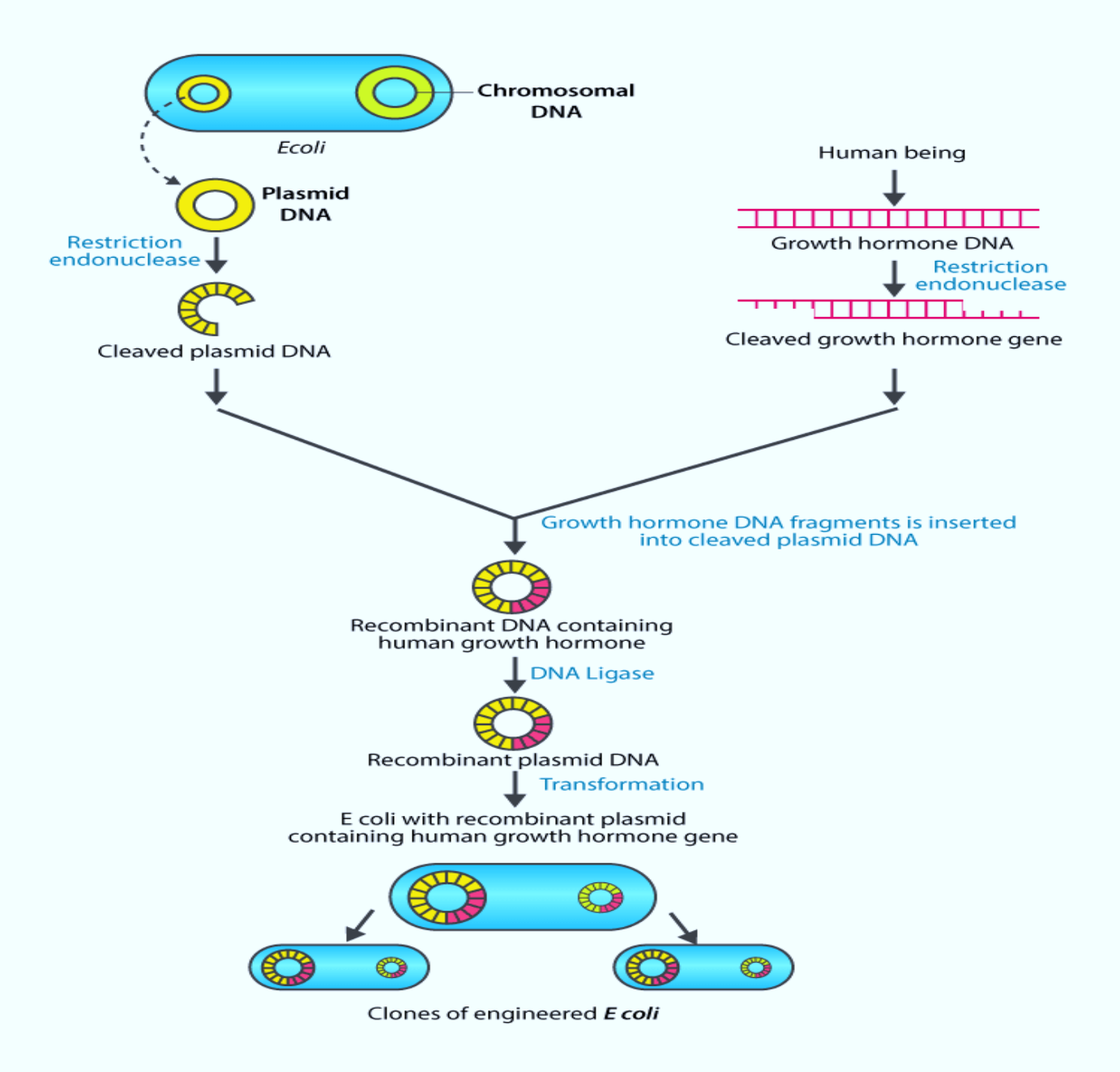
Ans: Cry proteins are the toxins produced by the bacteria Bacillus thuringiensis, encoded by cry genes. These proteins are initially in their inactive form until they are ingested by insects, which have an alkaline gut pH that activates the toxins. The activation of Cry proteins results in the lysis of epithelial cells in the insect, ultimately leading to its death. As a result, scientists have utilized this protein to develop transgenic crops with insect-resistant properties, including Bt corn and Bt cotton.

5. What is gene therapy? Illustrate using the example of adenosine deaminase (ADA) deficiency.

Ans: Gene therapy is the process of correcting malfunctioned genes by either inserting the desired gene or repairing and manipulating them. It encompasses a variety of techniques that allow for the correction of gene defects. Through this therapeutic approach, genes are introduced into the cells and tissues of an individual to address a particular disease. Adenosine deaminase deficiency (ADA) is a rare genetic disorder resulting from the deletion of the gene responsible for adenosine deaminase. This enzyme plays a crucial role in the proper functioning of the immune system. Gene therapy can be utilized to treat this disorder by transfecting the gene into early embryonic cells of the bone marrow for long-term effectiveness.

6. Diagrammatically represent the experimental steps in cloning and expressing a human gene (say, the gene for growth hormone) into a bacterium like E. coli.

Ans: DNA cloning is a method used to create numerous copies of a specific template DNA, utilizing a vector to transport the foreign DNA fragment into the host cell. The process involves the replication and transfer of genes, such as the growth hormone, into E.coli is depicted below:



7. Can you suggest a method to remove oil (hydrocarbon) from seeds based on your understanding of rDNA technology and the chemistry of oil?

Ans: Recombinant DNA technology, also known as rDNA, is a method utilized to manipulate the genetic material of an organism in order to achieve specific outcomes. In order to obtain the desired results, it is crucial to identify the genes responsible for oil production in seeds. By employing restriction endonucleases, the relevant genes can be extracted. The resulting DNA must then be treated with DNA ligases to mend any breaks in the DNA strands. When these cells are cultivated under sterile conditions on a nutrient-rich medium, they will develop into a new plant that produces oil-free seeds.

8. Find out on the internet what is golden rice.

Ans: Golden rice, a type of Oryza sativa, has been genetically modified to contain high levels of Vitamin A in order to address deficiencies in areas where this nutrient is lacking. The rice variety includes beta-carotene, a precursor to Vitamin A, which is inserted into the rice through genetic engineering. While rice plants

naturally produce beta-carotene in their leaves, it is not present in the endosperm of the seed due to its role in photosynthesis. By incorporating beta-carotene into the rice, it serves as a simpler and more cost-effective alternative to traditional Vitamin A supplements. Despite its potential benefits, golden rice has faced opposition from environmental activists and is not yet approved for human consumption.

9. Does our blood have proteases and nucleases?

Ans: No, blood does not have proteases and nucleases. But some proteases do exist in their inactive form. If it would have been found in blood and cells, it would have been digested.

10. Consult the internet and find out how to make orally active protein pharmaceuticals. What is the major problem to be encountered?

Ans: Orally active protein products, such as vaccines for infectious diseases like herpes, hepatitis B, and influenza, are successfully manufactured by isolating antigen genes from bacteria and cultivating them with cut leaf portions in an antibiotic medium of a potato plant to form callus. The transgenic/recombinant potato containing the vaccines is then acquired. However, protein pharmaceuticals can be degraded by proteases in the digestive system when taken orally, so it is crucial to protect them. Encapsulating these active protein pharmaceuticals in formulations or liposomes helps in their transfer. Despite these advancements, oral administration of proteins or peptides still faces challenges, as the proteases in the stomach can denature them, rendering them ineffective. To address this issue, a tablet is designed with a coating that resists digestion in the stomach but dissolves in the intestines, allowing for the absorption of proteins by the villi. This protective covering ensures that the therapeutic proteins remain intact until they reach the intestines.