

12. Biotechnology and its Applications

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

- (a) bacteria are resistant to the toxin
- (b) toxin is immature;
- (c) toxin is inactive;
- (d) bacteria encloses toxin in a special sac.

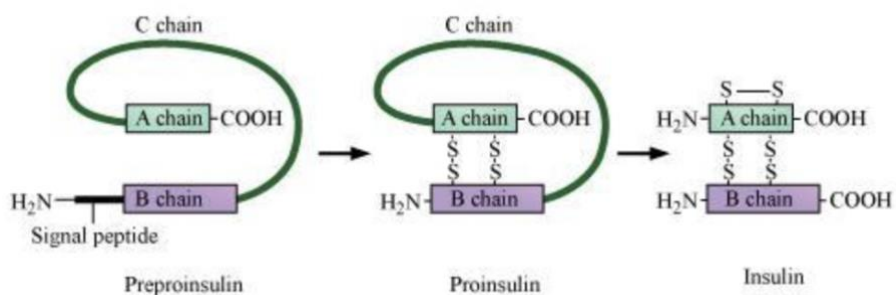
Answer: Cry proteins produced by some of the Bt strains do not kill the bacteria themselves because the toxin is inactive. In bacteria, the toxin is present in an inactive form, called as prototoxin, which gets converted into active form when it enters the body of an insect. It combines with the intestinal receptors of certain specific insects.

So, the correct answer is option C.

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

Answer: Transgenic bacteria contain foreign gene that is intentionally introduced into its genome. They are manipulated to express the desirable gene for the production of various commercially important products.

An example of transgenic bacteria is *E.coli*. In the plasmid of *E.coli*, the two DNA sequences corresponding to A and B chain of human insulin are inserted, so as to produce the respective human insulin chains. Hence, after the insertion of insulin gene into the bacterium, it becomes transgenic and starts producing chains of human insulin. Later on, these chains are extracted from *E.coli* and combined to form human insulin.



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

Answer: GM crops are genetically modified crops that can be made by transferring desirable characteristics in them. The main advantage of GM crops is that they are highly productive and they yield an increased amount of produce. The other advantages of the production of genetically modified crops in order to increase the yield are as follows:

1. GM crops can be developed for increasing the nutritional quality of crop products. For example golden rice with enhanced vitamin, A content is a GM crop.
2. Many GM crops are developed to have insect pest resistance, thus, decreasing our dependence on chemical-based insecticides/pesticides.
3. GM crops are made to be highly tolerant of environmental conditions.
4. Gm crops are highly tolerant to abiotic conditions
5. GM Crops minimises post-harvesting losses.

GM crops possess some disadvantages also. The presence of a transgene in commercial crops endangers wild species. The gene for Bt toxin expressed in pollen endangers pollinators such as honeybees. These crops supply allergens and transfer antibiotic resistance markers. They are damaging to the genetic environment.

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

Answer: 1. Cry proteins refer to the protein crystals containing a toxic insecticide.

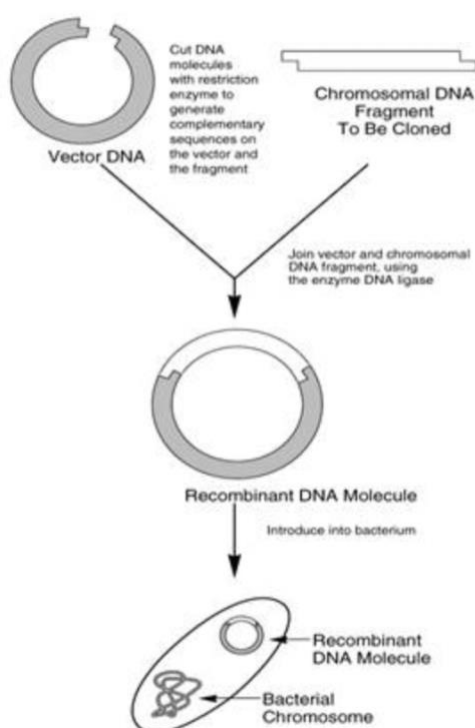
2. It is produced by soil bacterium, *Bacillus thuringiensis*.
3. The genes encoding cry proteins called Bt toxin genes were isolated from *B. thuringiensis* and incorporated into several crop plants such as Bt cotton, Bt corn, etc, to provide resistance against insect pests.

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

Answer: Gene therapy is the process of introduction of DNA into an organism e.g. human beings in order to treat a disease. It is used to replace a missing gene product or to correct mutant alleles. ADA is an autosomal-recessive inherited disorder that occurs due to defective adenosine deaminase (ADA) enzyme. People with this enzyme deficiency suffer from severe combined immunodeficiency (SCID) conditions. Human gene therapy trial can be used for ex vivo introduction of functional ADA gene in bone marrow cells of the patient, suffering from SCID. For this process, an engineered retrovirus containing a functional ADA gene is used to transfer the ADA gene into stem cells isolated from the patient with SCID. The treated cells or modified cells with the good ADA gene are reintroduced into the patient's marrow.

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

Answer: Diagrammatic representation of steps in DNA cloning



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

Answer: Recombinant DNA technology (rDNA) is a technique used for manipulating the genetic material of an organism to obtain the desired result. For example, this technology is used for removing oil from seeds. The constituents of oil are glycerol and fatty acids. Using rDNA, one can obtain oilless seeds by preventing the synthesis of either glycerol or fatty acids. This is done by removing the specific gene responsible for the synthesis.

Question 8. Find out from internet what is golden rice.

Answer: Golden rice is new genetically modified rice variety (*Oryza sativa*). It is produced to biosynthesize beta-carotene for the synthesis of vitamin A. It is rich in vitamin A content. It was created by Peter Beyer. It is intended to produce a fortified food to be grown and consumed in areas with a shortage of dietary vitamin A.

Question 9. Does our blood have proteases and nucleases?

Answer: Human blood does not include these enzymes, nucleases and proteases. In human beings, blood serum comprises various types of protease inhibitors that protect the blood proteins from being broken down by the action of proteases. The enzyme, nucleases, is also found absent in the blood.

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

Answer: Orally active protein pharmaceuticals contain biologically active proteins, peptides etc. These are taken into the body by oral route in various formulations. The production of these protein pharmaceuticals involves encapsulation of proteins or peptides in liposomes using penetration enhancers. These proteins or peptides are used for the treatment of diseases and they can also be used as vaccines.

The major problem encountered in the administration of these pharmaceuticals is that they are ingested orally, and digested by the proteases present in the stomach before showing results. This is why such pharmaceuticals are directly ingested into the target site.