

Chapter 12 Biotechnology and Its Applications

Exercise

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.

Solution 1:

(c) Toxin is inactive.

In bacteria, the toxin is present in an inactive form called Prototoxin, which gets converted into active form when it enters the body of an insect.

Question 2:

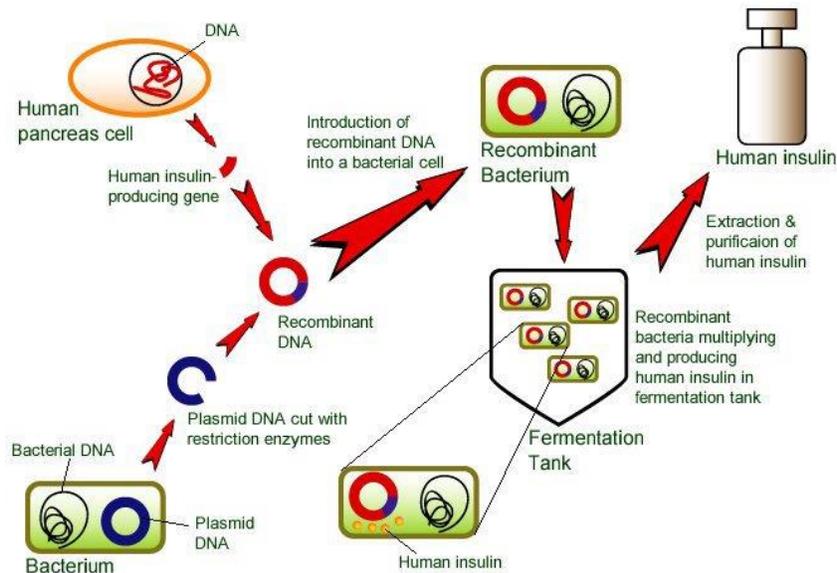
What are transgenic bacteria? Illustrate using any one example.

Solution 2:

Bacteria carrying foreign gene which is introduced into the bacterial plasmid/genome are called transgenic bacteria. These are manipulated to express the desired gene of interest for the production of commercially important products as medicines etc.

For example, two DNA sequences (A and B chains of human insulin) were introduced into in the plasmid of E.coil bacteria. This transgenic bacteria now starts producing human insulin chains. Afterwards, these chains were isolated from E.coli and combined so as to form human insulin.

Human Insulin Production



Question 3:

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

Solution 3:

	Advantages of GM	Disadvantages of GM
1	Replenishment of soil.	Danger of generating super weeds.
2	Tolerance to stress	Introduction of undesirable variety with harmful combination.
3	Greater productivity	High danger of non-reproduction / in-viability.
4	Less reliance on chemical pesticides.	Chemical produced may cause rejection in human insecticide.

Question 4:

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

Solution 4:

Cry proteins are produced by cry gene and these are toxins, responsible for killing insects as lepidopterans (tobacco budworms), coleopterans and dipterans and their larvae. It is secreted by *Bacillus thuringiensis*. Man exploited gene encoding this toxin, by introducing it into different plant's genome such as cotton genome with the help of *Agrobacterium* T-DNA as vector and developed transgenic plants, for e.g., Bt cotton and many other transgenic plants.

Question 5:

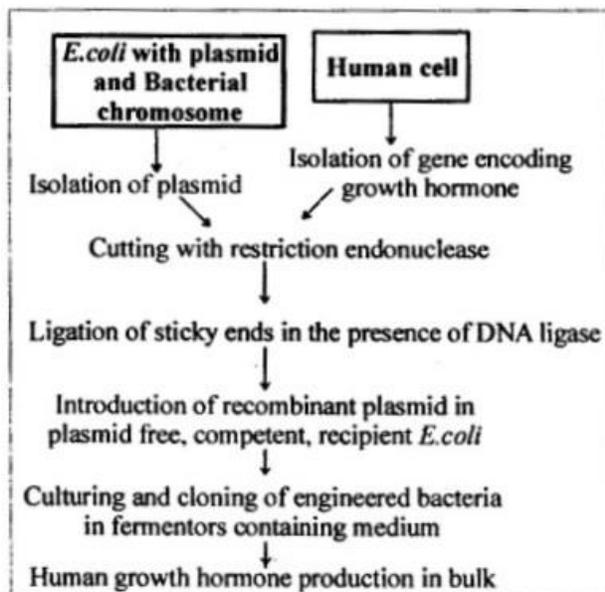
What is gene therapy? Illustrate using the example of adenosine deaminase (ADA) deficiency.

Solution 5:

Gene therapy is the correction of malfunctioning gene by repairing or inserting required normal gene or manipulation of that. ADA (adenosine deaminase deficiency) is a very rare genetic disorder due to deletion of the gene for adenosine deaminase. The enzyme is crucial for the immune system to function. It can be treated by gene therapy. This gene is transfected into early embryonic cells of bone marrow for permanent use.

Question 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*?

Solution 6:

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Question 7:

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

Solution 7:

Recombinant DNA technology (rDNA) is a technique used for manipulating the genetic material of an organism to obtain the desired result.

The genes for the formation of oil in the seed should be identified. The appropriate genes should be removed with the help of restriction endonucleases. Such DNA should then be treated with DNA ligases to seal DNA at the broken ends. These cells when grown aseptically on nutrient medium will differentiate into a new plant whose seeds will not have oil in them.

Question 8:

Find out from internet what is golden rice.

Solution 8:

Golden rice is transgenic plant of rice, *Oryza sativa*, having gene coding for precursor of pro vitamin A, called as beta carotene. Golden rice was developed by Swiss Federal Institute of Technology, rich in vitamin A (beta carotene), and this fulfills the shortage of dietary vitamin A. The rice grains are golden yellow in colour due to colour it gets from the beta carotene. However, this variety of rice has faced a significant opposition from environment activities. Therefore, they are still not available in market for human consumption.

Question 9:

Does our blood have proteases and nucleases?

Solution 9:

No, blood does not have protease and nuclease. If it would have been there blood and cell would have been digested, some protease does exist in inactive form.

Question 10:

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

Solution 10:

Orally active protein product that is successfully manufactured is vaccines for preventions of infectious diseases such as hepatitis B, herpes, influenza, etc. Gene for antigen are isolated from bacteria and grown along with cut leaf portions of potato plant in antibiotic medium – followed by callus formation and recombinant / transgenic potato are obtained which contain those vaccines.

The problem with the protein pharmaceuticals is that they can be degraded by proteases of digestive system in the alimentary canal. Thus, this is required to protect therapeutic proteins from proteases of digestive system, if taken orally. Orally taken such active protein pharmaceuticals are encapsulated proteins or peptides in liposomes or formulations, which facilitates their delivery also.