

Chapter.12

Biotechnology and its Applications

Class – XII

Subject –Biology

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.1

Toxin is inactive

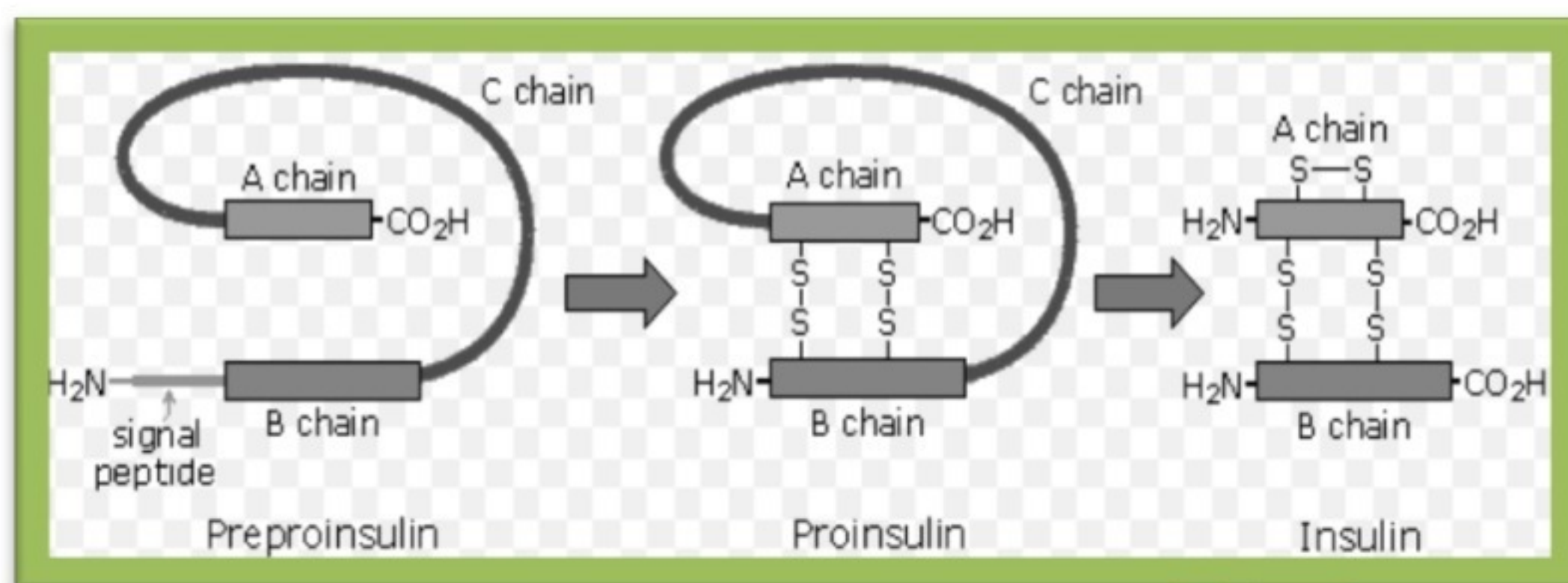
The inactive form of toxin is called prototoxin and get converted in to active form when enter in to the body

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

Answer.2

Foreign gene present in transgenic is intentionally introduced into its genome. Manipulation is required to express the desirable gene for the production of various commercially important products. An example of transgenic bacteria is E .coli the two DNA sequences corresponding to A and B chain of human insulin are inserted, so as to produce the respect human insulin chains. Hence, the bacterium becomes transgenic and starts producing chains of human insulin after the insertion of insulin gene. Later

on, these chains are extracted from E.Coli and combined to form human insulin



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

Answer.3

The production of genetically modified (GM) or transgenic plants has several advantages.

- (i) The post harvesting loss of crops can be decreased by the use of GM crops. However, there are certain controversies regarding the use of genetically modified crops around the world. In an area, the native biodiversity can be affected by the use of GM crops. For example, the use of Bt toxin to decrease the amount of pesticide is posing a threat for beneficial insect pollinators such as honey bees. If the gene expressed for Bt toxin gets expressed in the pollen, then the honey bee might be affected. As a result, the process of pollination by honey bees would be affected.

- (ii) GM crops are mostly developed for pest resistance, which increases the crop productivity and therefore, reduces the dependency on chemical pesticides.
- (iii) GM crops are developed to increase the nutritional quality. For example, golden rice is a transgenic variety in rice, which is rich in vitamin A
- (iv) GM plants are also accountable to prevent the loss or fertility of soil by increasing the efficiency of mineral usage.
- (v) They are highly tolerant to unfavorable abiotic conditions.

4. What are Cry proteins? Name the organism that produces it. How has man exploited this?

Answer.4

Cry genes are mainly responsible to encode the Cry proteins. These proteins are toxins, which are produced by *Bacillus thuringiensis* bacteria. This bacterium contains these proteins in their inactive form when the inactive toxin protein is ingested by the insect. Alkaline pH of the gut makes them active. This results in the lysis of epithelial cell and eventually the death of the insect. Therefore, man has exploited this protein to develop certain transgenic crops with insect resistance such as of cotton, Bt corn, etc.

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

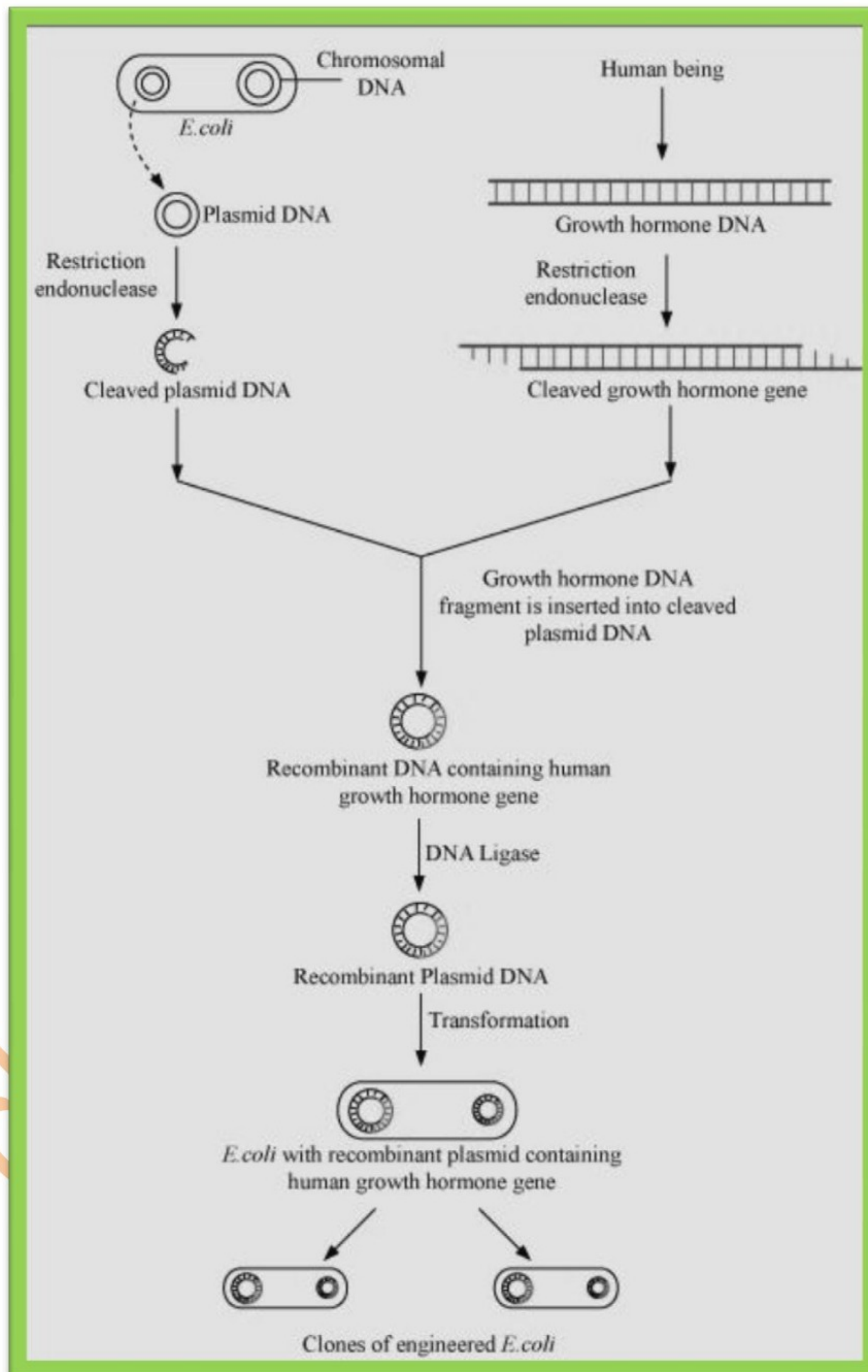
Answer.5

Correction of defective gene through gene manipulation by using the technology is known as gene therapy. It involves the delivery of a normal gene into the individual to replace the defective gene, for example, the introduction of gene for adenosine deaminase (ADA) in ADA deficient individual. The adenosine deaminase enzyme is accountable for the normal functioning of the immune system. This disorder can be cured by transplantation of bone marrow cells. The first step involves the extraction of lymphocyte from the patient's bone marrow. Then, a functional gene for ADA is introduced into lymphocytes with the help of retrovirus. These treated lymphocytes containing ADA gene are then introduced into the patient's bone marrow. Once the gene gets activated, it will produce functional T- lymphocytes and activating the patient's immune system.

- 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?**

Answer.6

Producing multiple identical copies of specific template DNA. It involves the use of a vector to carry the specific foreign DNA fragment into the host cell. The mechanism of cloning and transfer of gene for growth hormone into E.Coli is represented below



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

Answer.7

To get the desired product, we need to manipulate the genetic material of an organism and this can be done by recombinant DNA technology (rDNA). 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 oil less seeds by preventing the synthesis of either glycerol or fatty acids. This is done by removing the specific gene responsible for the synthesis.

- 8. Find out from internet what is golden rice**

Answer.8

Golden rice is a genetically modified variety of rice, *oryza sativa*, which has been developed as a fortified food for areas where there is a shortage of dietary vitamin A. It contains a precursor of pro-vitamin A, called beta-carotene, which has been introduced into the rice through genetic engineering. The rice plant naturally produces beta-carotene pigment in its leaves. However, it is absent in the endosperm of the seed. This is because beta-carotene pigment helps in the process of photosynthesis while photosynthesis does not occur in endosperm. Since beta-carotene is a precursor of pro-vitamin A, it is introduced into the rice variety to fulfill the shortage of dietary vitamin A. It is simple and a less expensive alternative to vitamin supplements. However, this variety of rice has faced a significant opposition from environment activists. Therefore, they are still not available in market for human consumption.

9. Does our blood have proteases and nucleases?

Answer.9

No. human blood does not include the enzymes, nucleases and proteases. In human beings, blood serum contains different types of protease inhibitors, which protect the blood proteins from being broken down by the action of protease. The enzyme, nucleases, catalyses the hydrolysis of nucleic acids that is absent in blood.

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

Answer.10

Orally active protein pharmaceuticals contain biologically active materials such as peptides or proteins, antibodies, and polymeric beads. It is administered orally into the body through various formulations. It involves the encapsulation of protein or peptide in liposome's or formulations using penetration enhancers.

These proteins or peptides are used for treatment of various diseases and are also used as vaccines however; the oral administration of these peptides or proteins has some problems related to it. Once these proteins are ingested, the proteases present in the stomach juices denature the protein. As a result, their effect will be nullified. Hence, it is necessary to protect the therapeutic protein from digestive enzymes, if taken orally; this is the reason for the proteins to be injected directly into the target site.