EXERCISE PAGE NO. 215 - 216

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:

(c) toxin is inactive

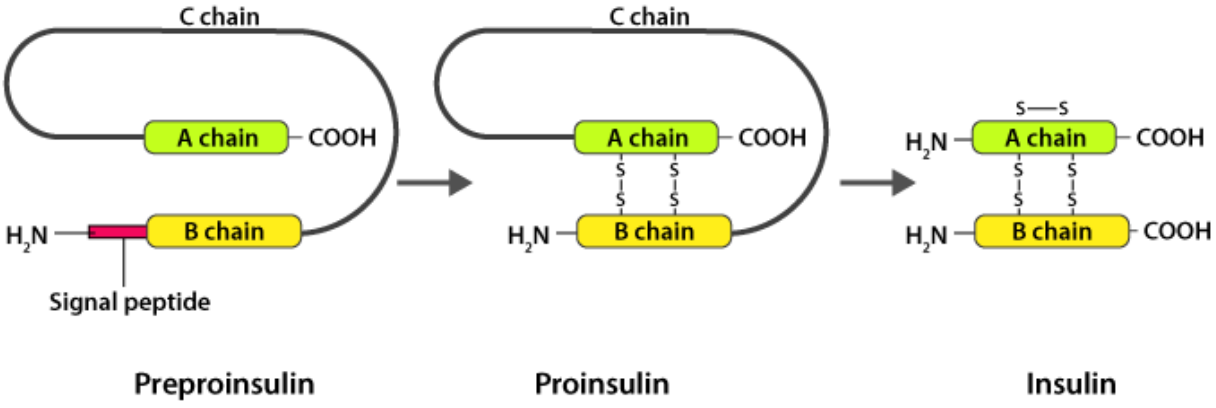
Toxins in bacteria are found in an inactive form known as protoxin. This gets converted into an active form when it moves into the body of an insect.

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

Solution:

Transgenic bacteria comprise of a foreign gene which is purposefully inserted into its genome. These are manipulated in order to be able to express the desirable gene to produce different commercially important products.

E.coli, an example of transgenic bacteria has two DNA sequences in its plasmid that corresponds to A and B chain of human insulin which are introduced to generate the respective human insulin chains. Therefore, once the insulin gene is introduced into the bacterium, it turns transgenic and begins to produce chains of human insulin. These chains, after sometime are extracted from E.coli and fused to form human insulin.



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

Solution:

Advantages of producing genetically modified crops are:

(i) Genetic modification makes crops more tolerant to abiotic stresses – namely cold, drought, heat, salt etc

(ii) Genetic modification creates tailor-made plants to supply alternative resources to industries, in the form of fuels, starches, pharmaceuticals etc

(iii) Most of the crops produced this way are for pest resistance, that increases crop productivity and hence reduces the dependence on chemical pesticides

(iv) Genetic modification has made it possible to develop crops that enhance the nutritional quality. For instance, one of the transgenic variety of rice, golden rice, is rich in Vitamin A.

(v) They are useful in reducing the losses that are incurred post-harvest

(vi) Early exhaustion of soil fertility is prevented due to increased productivity of mineral usage by plants

Disadvantages of producing genetically modified crops are:

(i) Danger of introducing undesirable variety as a result of a destructive combination

(ii) There is a threat of producing super weeds

(iii) There is a high risk of non-reproduction from genetically modified crops

(iv) The chemicals that are produced, may cause a rejection in the human insecticides

(v) Genetically modified crops affect human health as they supply allergens and several other antibiotic resistance markers in the body

(vi) These crops can affect the native biodiversity in an area as they can cause genetic pollution in the wild relatives of crop plants.

For instance, the Bt toxin is posing a threat, which is used to decrease the amount of pesticide for the benefit of insect pollinators such as the honey bee. If the gene expressed for Bt toxin gets expressed in the pollen, the honey bee might get affected leading to the pollination by honey bees getting affected.

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

Solution:

Cry proteins are the toxins encoded by cry genes and produced by the bacteria – Bacillus thuringiensis which contains these proteins in its inactive form. It gets activated due to the alkaline pH of the gut of the insect when it ingests the inactive toxin protein. This leads to the lysis of epithelial cells and ultimately the insect dies. Hence, we say that man has exploited this protein to produce some transgenic crops with the property of insect-resistance such as Bt corn, Bt cotton etc.

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

Solution:

The process of correction of malfunctioned genes either by inserting the desirable gene or repairing or manipulating them is referred to as gene therapy. It is a collection of methods which enables the correction of a gene defect. In this therapy, the gene is inserted into the cells and tissues of a person to treat a disease.

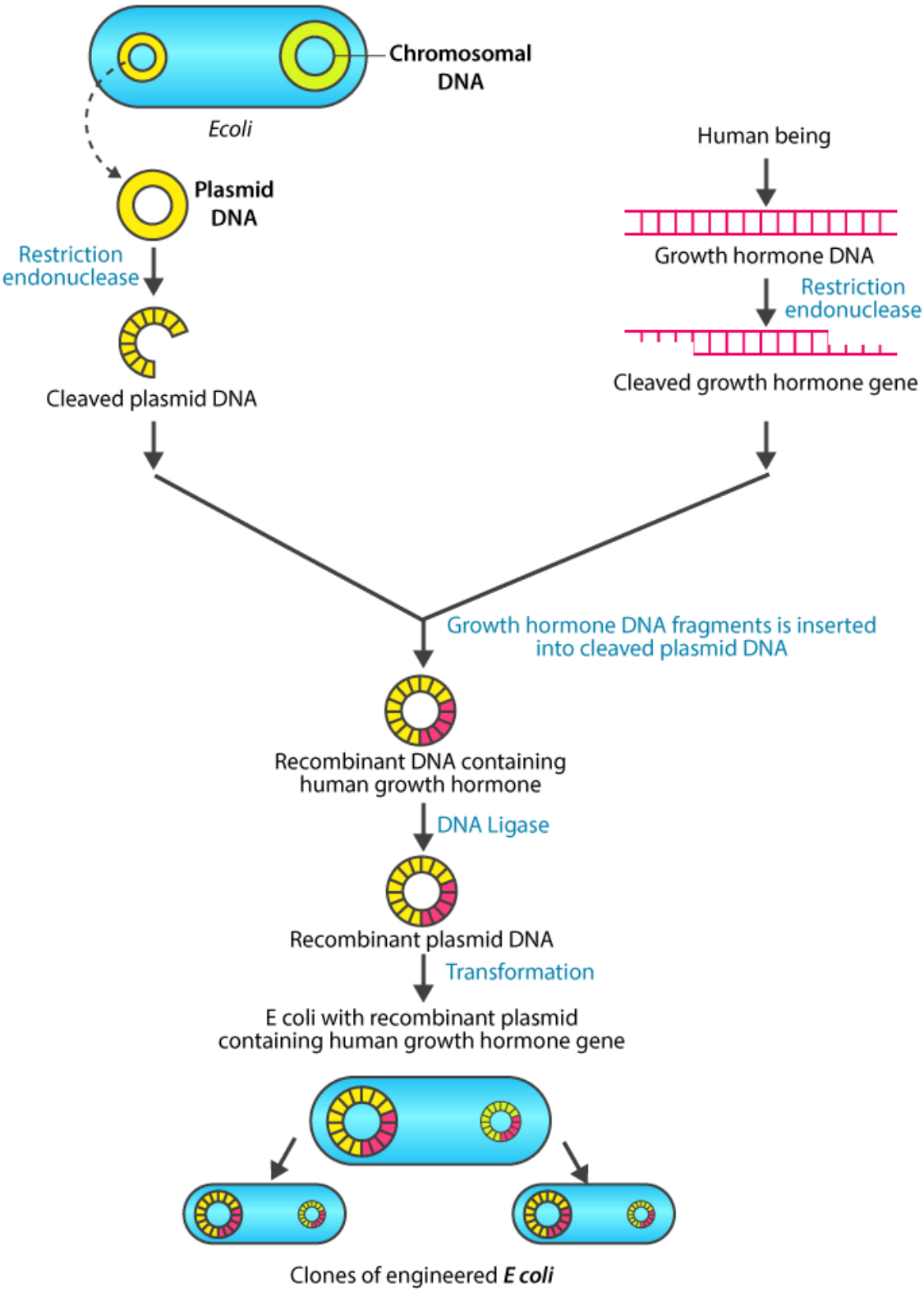
Adenosine deaminase deficiency (ADA) is a rare genetic disorder caused due to deletion of the gene for adenosine deaminase. This enzyme is critical for the normal functioning of the immune system. This disorder can be treated by gene therapy wherein the gene is transfected into early embryonic cells of the bone marrow for permanent utilization.

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

Solution:

A technique of producing multiple identical copies of a particular template DNA is known as DNA cloning which involves the usage of a vector that carries the particular foreign DNA fragment into the host cell.

The working of cloning and transfer of gene for growth hormone into E.coli can be depicted as given below:


Chromosomal DNA
Ecoli
Plasmid DNA
Restriction endonuclease
Cleaved plasmid DNA
Human being
Growth hormone DNA
Restriction endonuclease
Cleaved growth hormone gene
Growth hormone DNA fragments is inserted into cleaved plasmid DNA
Recombinant DNA containing human growth hormone
DNA Ligase
Recombinant plasmid DNA
Transformation
E coli with recombinant plasmid containing human growth hormone gene
Clones of engineered E coli

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

Solution:

Recombinant DNA technology or rDNA is a technique which is used for the manipulation of the genetic material of an entity in order to obtain desired results. For this, the genes that are necessary for oil formation in seeds must be recognized. With the help of restriction endonucleases, appropriate genes should be removed. The DNA thus obtained must be treated with DNA ligases to seal the broken ends of the DNA. When cultivated aseptically on a nutrient medium, these cells will differentiate into a new plant possessing seeds with no oil.

8. Find out from internet what is golden rice.

Solution:

Golden rice, a variety of rice, Oryza sativa is a genetically modified crop which is developed as a fortified food to supply them to areas where there is scarcity of dietary Vitamin A, as golden rice is richly supplied with Vitamin A. Golden rice consists of a precursor of pro-Vitamin A, known as the beta-carotene, inserted into the rice through the process of genetic engineering.

Rice plants synthesize the beta-carotene pigment naturally in its leaves but it is not found in the seed's endosperm as the pigment aids in photosynthesis and photosynthesis does not take place in the endosperm. As the beta-carotene is a precursor of pro-vitamin A, it is inserted into the rice variety to compensate for the dearth of dietary Vitamin A. Compared to vitamin supplements, this is a simpler and low-priced alternative. But they are still not available for human consumption, as this variety of rice has faced a considerable opposition from environmental activists.

9. Does our blood have proteases and nucleases?

Solution:

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

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

Solution:

Successfully manufactured orally active protein product are vaccines used to prevent infectious diseases such as herpes, hepatitis B, influenza and so on. The genes for antigen are isolated from bacteria and cultivated along with cut leaf portions in an antibiotic medium of a potato plant. Then the callus is formed and the transgenic/recombinant potato is acquired containing the vaccines.

But, protein pharmaceuticals can be degraded by proteases of the digestive system in the alimentary canal. Hence, if taken orally, it is essential to safeguard therapeutic proteins from proteases of digestive system. Such active protein pharmaceuticals, when orally taken, are encapsulated proteins or peptides in formulations or liposomes which facilitates their transfer also. These peptides or proteins are used as vaccines to treat various diseases.

But, oral administration of these proteins or peptides poses some problems related to it. Once these proteins are ingested, the proteases found in the stomach juices denature the proteins hence their effect is nullified.

Making of orally active protein pharmaceutical:

(i) Proteins are inserted in a tablet whose coating is made of a material which is not digested by the stomach's acidic medium but dissolves in the intestines causing the proteins to get absorbed by villi of the intestine

(ii) This is to protect the therapeutic proteins with a covering which will get dissolved after it passes through the stomach