

Class: 12
Subject: Biology
Topic: Biotechnology and its applications
No. of Questions: 25

Q1. What are transgenic bacteria? Illustrate using any one example.

Sol. When a foreign gene or series of genes are intentionally introduced into the genome of bacterium, the later becomes transgenic. For example, two DNA sequences (A and B chains of human insulin) were introduced into the plasmid of bacteria E. coli. The transgenic bacteria start producing insulin chains.

Q2. Compare and contrast the advantages and disadvantages of production of genetically modified crops.

Sol. Transgenic plants have definitely several advantages such as –

- a. They increase productivity of crops generally by showing resistance against plant pathogens and to some herbicides.
- b. They develop crop varieties with added vitamins and minerals. Thus, the GM crops have enhanced nutritional quality and yield.
- c. Transgenic crops grow well in saline soil and show salt tolerance.

Disadvantage: However, the introduction of transgenic crops into agriculture has also created controversies. Transgenes in commercial crops can endanger native species. For example, the gene for Bt toxin expressed. In pollen might endanger pollinators like honeybees. These crops cause problems in human health by supplying allergens and transfer of antibiotic resistance markers. They cause damage to the natural environment. Transgenic crops are always costly so that they are adverse to the interest of the farmers.

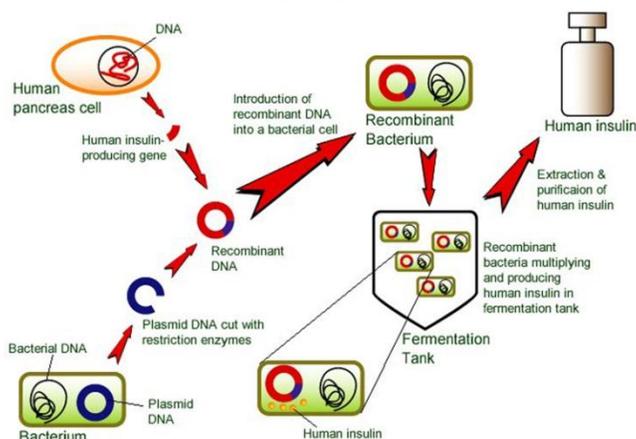
Q3. What are cry proteins? Name an organism that produce it. How has man exploited this protein to his benefit?

Sol. Cry proteins are encoded by the genes named cry. They are produced in *Bacillus thuringiensis*. Cry proteins are toxic to insects and act as insecticides. Man has developed several transgenic crops by introducing these genes from bacteria to crop plants such as Bt cotton, Bt corn, tomato, etc.

Q4. Diagrammatically represent the experimental steps in cloning and expressing the human gene (say the gene for growth hormone) into a bacterium like E. coli.

Sol:

Human Insulin Production



Q5. Can you suggest a method to remove oil (hydrocarbon) from seeds based on your understanding of rDNA technology and chemistry of oil?

Sol. In involves metabolic engineering to transform an oil (hydrocarbon) producing seed into an oil less seed. This can be done by identifying the specific enzyme involved in biosynthesis of oil and then repressing the gene responsible for synthesizing that particular enzyme.

Q6. Does our blood have proteases and nucleases?

Sol. Yes, our blood contains proteases and nucleases which help to degrade the foreign agents such as proteins and genetic materials.

Q7. Which is the most effective application of monoclonal antibodies?

Sol. The most effective clinical application of monoclonal antibodies is immune suppression for kidney transplantation.

Q8. What are hybridomas?

Sol. Fusion of myeloma cells and antibody-producing cells results in the formation of fused cells called hybridomas.

- Q9. What was the speciality of the milk produced by the transgenic cow Rosie?
- Sol. The first transgenic cow – Rosie, produced human protein–enriched milk that contained the human alpha-lactalbumin (204 gms per litre). This milk was more balanced and good for human babies as compared to natural cow milk.
- Q10. Name a few important products of biotechnology.
- Sol. A few important products of biotechnology are – alcohols, organic acids, enzymes, vitamins, steroids, monoclonal antibodies, insulin, etc.
- Q11. What are the areas which have been responsible for the recent advances in biotechnology?
- Sol. The area in recent advance in biocenology are – (i) Agriculture (ii) Medicine (iii) Food industry (iv) Fermentation technology (v) Environmental engineering, and (vi) Genetic engineering.
- Q12. What is difference between conventional agriculture practices and modern agriculture practices.
- Sol. Conventional agricultural practices, with the sue of locally available good quality seeds, compost, manure and biofertilisers, are more ecofriendly whereas modern agricultural practices are causing ecological damage due to enormous exploitation of natural resources and unmanageable amount of by-products and wastes that are being constantal added into the atmosphere.
- Q13. Nematode-specific genes are introduced into the tobacco plants using Agrobacterium vectors to develop resistance in tobacco plants against nematodes. Explain the events that occur in tobacco plants to develop resistance.
- Sol. Initially the nematode specific gens were introduced into the host plant (tobacco). This was done by using Agrobacterium as vectors. Introduction of DNA was made to produce both sense and anti-sense RNA in the host cells. These RNA molecules were complementary to each other so they formed a double stranded RNA (ds RNA). This ds RNA initiated RNA interference (RNA i) and finally silenced the specific mRNA of the nermatode. In this way the tobacco plants develop resistance.

Q14. How did Eli synthesise the human insulin? Mention one difference between this insulin and the one produced by human pancreas.

Sol. Eli Lilly company prepared two DNA sequences coding for chain A & B of human insulin and introduced it into the plasmids of E coli, which was utilised to produce insulin. Insulin from animal source caused allergy in some patients. In humans, insulin is synthesized as a prohormone which has one extra stretch called c-peptide.

Q15. A. Write name of the first transgenic crop in India.
B. Insulin is extracted from which microorganism?
C. Which enzyme is most commonly used for the crop improvement in genetic engineering?

Sol.

- A transgenic crop is a crop that contains a transgene i.e., a foreign gene is introduced and stably integrated into the host DNA. The name of first transgenic crop produced in India is tobacco (*Nicotiana tabacum*).
- Insulin producing genes from the human being have been introduced into the bacteria – *Escherichia coli* (*E. coli*). The genetically modified bacterium *E. coli* produces insulin called Humulin. This insulin is extracted from *E. coli* for clinical use.
- The enzyme – restriction endonuclease is most commonly used for crop improvement in genetic

Q16. How is 'Rosie' considered different from a normal cow?

Sol. 'Rosie' is a first transgenic cow. Human genes are transferred in such cow which are expressed in mammary tissue. The milk contains the human α -lactalbumin which is nutritionally a more balanced product for human bodies than natural cow milk.

Q17. Describe the gene therapy procedure for and ADA-deficiency patient.

Sol. Gene therapy of ADA deficiency:

- Lymphocytes isolated from patient's blood are cultured in-vitro.
- Functional ADA cDNA are then introduced into the cultured lymphocytes.
- These lymphocytes are returned back to the patient's body.
- Lymphocytes are not immortal. Therefore, repeated infusion of genetically engineered lymphocytes is required.
- Permanent cure-Introduction of gene isolated from bone marrow cell-producing ADA into cells at early embryonic stages.

Q18. Why is proinsulin so called? How is insulin different from it?

Sol. Insulin used for diabetes was earlier extracted from pancreas of slaughtered cattle and pigs. Insulin consists of two short polypeptide chains: chain A and chain B that are linked together by disulphide bridge.

In mammals, including humans, Insulin is synthesized as a prohormone (like a proenzyme, the pro-hormones also need to be processed before it becomes a fully mature and functional hormone) which contains an extra stretch called the C peptide.

Q19. A. Define cloning. What are its benefits?

B. Describe transgenics. Write briefly about a transgenic crop that has been introduced in India.

Sol.

- a. The production of one individual organism or a group of organisms of identical genotype or cells that have been derived from a single parental organism or cell by some kind of asexual reproduction or parthenogenesis. There are two types of cloning – gene cloning at molecular level and cell or organism cloning. Cloning is beneficial in DNA- finger printing, DNA- probe, gene therapy and called genetically modified. Crops or GM crops.
- b. An organism which becomes transformed following the introduction of new DNA sequence into its genome is called transgenic organism. Most popularly the transgenic crops are called genetically modified crops or GM crops.

A transgenic crop that has been recently introduced in India is Bt cotton. This transgenic variety of cotton contains a foreign gene obtained from a soil bacterium – *Bacillus thuringiensis*. The bacterium produced a crystal (Cry) protein which is toxic to larvae of certain insects. The gene responsible for production of Cry protein, i.e., cry gene, has been isolated and introduced into the cotton genome so that the transgenic Bt cotton has become insect resistant. The Bt cotton is now grown in different parts of India and has resulted approximately 3% to 27% increase in cotton yield.

Q20. A. Why are transgenic animals so called?

B. Explain the role of transgenic animals in (i) vaccine safety and (ii) biological products with the help of an example each.

Sol. Transgenic animals are called so as these animals possess the deliberate modification of their genome. The changes in the genome of the organisms are brought about by recombinant DNA technology.

Role of transgenic animal in vaccine safety: Transgenic mice are being developed for use in testing the safety of vaccines before they are used on human.

Example: Transgenic mice are being used to test the safety of the polio vaccines. If successful and found to be reliable, they could replace the use of monkeys to test the safety of batches of the vaccine.

Role of transgenic animal in production of biological products: Transgenic cow, Rosie is used for the production of human protein – enriched milk, which contained D-actalbamin and was nutritionally more suitable for human babies.

Q21. Extranuclear genetic material is found in

- (A) Plastid and nucleus
- (B) Mitochondria and plastids
- (C) Nucleus and cytoplasm
- (D) Mitochondria and nucleus

Sol. (b)

Q22. The transgenic plant flavr savr tomato carries an artificial gene for

- (A) Delay ripening process
- (B) Longer shelf life
- (C) Added flavours
- (D) All of these

Sol. (D)

Q23. Eco RI is an

- (A) Ligase
- (B) Polymerase
- (C) Restriction enzyme
- (D) Gyrase

Sol. (C)

Q24. 'Nif gene' for nitrogen fixation in cereal crops like wheat, jowar etc. is introduced by cloning

- (A) *Rhizobium meliloti*
- (B) *Bacillus thuringiensis*
- (C) *Rhizopus*
- (D) *Rhizophora*

Sol. (A)

Q25. The most common plasmid vector used in genetic engineering is

- (A) PBR 328
- (B) PBR 322
- (C) PBR 325
- (D) PBR 330

Sol. (B)

askIITians