

2)

- ① Bt endotoxins are the insecticidal toxins produced by the bacteria *Bacillus Thuringiensis* (Bt).
- ② This Bt bacteria produces crystals during sporulation which contains these Bt endotoxins.
- ③ Mechanism of Action ⇒
- i) When the insect ingests the crystals, proteolysis of the crystals take place in the insect gut. During proteolysis, these crystals are broken down by the enzymes & the toxin is released.
  - ii) The toxin released then binds to receptors present on the surface of the insect gut.
  - iii) On binding to the receptors, the toxins paralyze the digestive tract of the insect and creates pores in the gut which leads to insect not consuming any food.
  - iv) As the consumption of food is stopped completely, the insect starves & eventually dies.

3)

- ① Zaragozic acid is one of the drugs isolated from micro-organisms.
- ② They are also called squalestatins, as they inhibit the action of enzyme called squalene synthase.
- ③ Squalene synthase is an enzyme present in human body which plays an important role in production of cholesterol in the body.
- ④ As the inhibit = squalene synthase, Zaragozic acids help in lowering cholesterol levels in the body.
- ⑤ Zaragozic acids are also observed to cure Prion - infected neurons & are therefore seen as an important drug in the case of prion - related diseases.

4)

- ① Entomopathogenic fungi are the fungi which are toxic to insects.
- ② These fungi are non-toxic to humans and animals, cause less environmental harm, can be produced easily & cheaply and because of these properties, they are seen as an alternative to chemical pesticides.
- ③ These fungi affect the insects by the outer contact.
- ④ Mode of action ⇒
- i) Spore Adherence ⇒ Spores of the fungi get attached to the outer part of the insects.

- 4) i) Form<sup>n</sup> of toxin cells  $\Rightarrow$  Post adherence, the fungi produces toxin cells on the insect surface.
- ii) Cuticle penetration  $\Rightarrow$  These toxin cells then penetrate the outer layer (cuticle) and go inside the insect body.
- iii) Blastophore form<sup>n</sup>  $\Rightarrow$  As these cells enter the insect body, blastophores are formed & the insect is eventually killed.

5)

- $\rightarrow$  ① One of the important applications of Transgenic plants is to improve the nutrition of the plants.
- ② This includes the improvement of expression of essential amino acids such as Lysine & methionine.
- ③ Improving Lysine Nutrition  $\Rightarrow$
- The way of improving lysine nutrition in plants is the down-regulation of lysine production.
  - In plants, the limited lysine production is because of the feedback inhibition of enzymes AK & DHOPO which help in form<sup>n</sup> of lysine.
  - Genes producing ~~is~~ these enzymes without feed back inhibition are isolated from E. coli & are introduced in the plant gene.
  - This transgenic plant is then observed to have increased lysine production.

(P.T.O)

④ Improving methionine production ⇒

There are 2 ways of improving methionine production ⇒

- Transfer of genes ⇒ Plants such as rice, maize, sunflower have been found to have genes producing sulphur rich proteins.

These genes are then transferred to other plants so that their "product" of sulphur rich proteins increases (i.e. methionine "product" ↑)

- Modifying DNA sequence ⇒ Here, plants producing proteins having less sulphur are taken. The DNA is isolated & the gene sequence producing these proteins are modified so that, the proteins now produced will have high sulphur content i.e. methionine content will increase.

Q)

- ① Beer is an alcoholic beverage produced by the metabolic process of fermentation.
- ② The Beer brewing process is of many steps. These are ⇒
- i) Malting ⇒ The Grain is germinated in this process & the starch present in grain is converted to sugar.
  - ii) Mashing + Wort formation ⇒ Here, the grains are milled to small parts and are then cooked <sup>with water</sup> to form wort. Hops are also added to enhance the flavour & the wort solution is cooled. The process includes small processing line Milling, Mashing, Cooking, Boiling, Adding Hops & Hops separation & cooling.
  - iii) Fermentation ⇒ Here, the sugar that is obtained through the previous steps are fermented to form ethanol. Two types of fermentation are there - Top fermentation & Bottom fermentation.

6  
iv) Bottling & Preservation  $\Rightarrow$  After fermentation, the beer formed is bottled into small containers & is preserved until consumption.

7(b)

- ① Metagenomics is the study of genomic DNA obtained from environmental samples.
- ② Traditionally, genomic analysis of only cultured organisms was done. As only 1% of total organisms in environment can be cultured, a large portion of organisms were left unchecked.
- ③ As metagenomics studies DNA from environmental samples, it is now possible to study all these organisms & hence, metagenomics has proved to be an important process as it has broadened the horizons of DNA analysis.
- ④ Applications of Metagenomics include  $\Rightarrow$  2/2
- a) Discovery of Novel Enzymes
  - b) Used in Drug discovery.
  - c) Novel organisms having new applications are discovered.
- ⑤ There are two approaches of metagenomic analysis  $\Rightarrow$
- a) Sequence Analysis  $\Rightarrow$  Here, DNA sequence fragments are joined & analysed.
  - b) Functional Analysis  $\Rightarrow$  Here, the gene is checked with other genes having similar functions.

8)

→ ① Acidophiles ⇒

a) Adaptation properties ⇒

i) Acidophiles survive in acidic environment by doing several adaptations.

ii) The surfaces of acidophiles consists of -vely charged Amino acids which protect the cell from acidic environment.

iii) The surface also has proton pumps to pump out  $H^+$  ions whenever required.

b) Industrial Application ⇒ Enzymes like Alcohol Dehydrogenase are formed by Acidophiles. This enzyme converts alcohol & has tons of industrial applications because of its surviving tendencies.

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② Alkaliphiles ⇒

a) Adaptation properties ⇒

i) Alkaliphiles survive in basic environment by having positively charged Amino acids on their surface.

ii) They also have acidic residues on their surface which can make the inside of cell less basic whenever required.

b) Industrial Applications ⇒ Alkaliphiles have many industrial Applications. They are primarily used as detergents, Xylanases etc.

a)  
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- ① Gene Pyramiding is a process where the transgenic plant is given more than 1 Bt toxin genes.
- ② This process is done to lower the chances of the insect to be Bt ~~resistant~~ toxin resistant.
- ③ Transgenic Insect resistant plants are generally created by transformation process. The steps are as follows. These are →
  - i) The Bt toxin gene is isolated from the Bt bacteria & is incorporated in the Ti plasmid of Agrobacterium Tumefaciens.
  - ii) This is then transferred into the plant cell & the plant cell grows to be a transgenic insect resistant plant.
- ④ We can also create transgenic plants by particle bombardment. Here, the gold & tungsten particle having the property is bombarded on the plant protoplast & this protoplant is then grown & thus, transgenic plant is formed.

12)

→ ① Receptors, known as Gut Cadherins are present on the surface of insect gut.

② The Bt toxin ~~can~~ bind to the Cadherins which leads to the pore formation in the insect gut & thus, eventually insect is killed.

③ Therefore, the ~~receptors~~ receptors play an important role in the action mechanism of the Bt toxins.

④ If the insect becomes toxin resistant, it can mean that the receptors has undergone some changes and therefore, is unable to bind to the toxins. So, it plays a major role in Bt toxin action.

13)

→ ① Proteinase enzyme is said to be an important enzyme which protects plants from insect pests.

② This enzyme is said to be toxic for insects in their larval stage.

③ This enzyme plays a major role in inhibiting the growth of larval insects & thus, protects the plants from the pests.

14)

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① Edible vaccines consist of any food which provide nutrients like protein, vitamins etc. which can prevent it can protect the human bodies from a particular disease.

② The efficacy of the edible vaccine depends on the candidate plant as well.

③ Some of the candidate plants which can be used as edible vaccines are → Tomato, Potato, Carrot, Rice etc.

④ Some properties in ideal candidate plants are →  
a) low cost of Production      b) Easily able to grow  
c) Have long shelf life      d) Doesn't get spoilt easily

⑤ Applications of Edible vaccines are →

a) Safe alternative for normal vaccine.

b) Creating vaccines which are accessible to all population.

15)

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① Probiotics are the "good" bacteria which are present in the intestinal gut.

② They perform some important functions such as →

a) Reducing the count of pathogenic bacteria

b) Increasing the intestinal permeability of the gut

c) Initiating immune response by IgA secretion

d) By these functions, we can observe that probiotics are very important to maintain the gut health of the body

④ Ex. of Probiotics → Lactobacillus casei, etc.

16)

- ① Bacteriorhodopsin is one of the proteins obtained through organisms of Archaea domain.
- ② It is one of the simplest proteins which perform the function of proton pump.
- ③ It is also one of the simpler photosynthetic proteins ~~which~~ <sup>as it</sup> does the conversion of green light ~~is~~ which eventually helps in ~~prote~~ ATP synthesis.
- ④ It has many industrial applications because of its toughness in extreme environment. It is used for various <sup>biological</sup> studies, in biosensors etc.

17)

- ① Thermophiles  $\Rightarrow$  These are the extremophiles which survive in high temperatures. As high temperature ~~undergoes~~ causes DNA denaturation, thermophiles undergo structural adaptation of forming proteins which can protect the DNA from denaturation. It also consists of chaperons which assist in binding of proteins.
- ② Psychrophiles  $\Rightarrow$  These are the extremophiles which survive in very cold climates. The structural adaptation which psychrophile go through is inclusion of more  $\alpha$ -helices & aromatic amino acids in the protein structures which assist in persisting in cold climates.

18)

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- ① Apple cider vinegar is the dilute acetic sol<sup>n</sup> formed by the fermentation of apple juice.
  - ② It is formed by double fermentation of sugar to ethanol & then ethanol to acetic acid.
  - ③ Some of the health benefits of apple cider vinegar is →
    - ⓐ Improves immune system
    - ⓑ Protects from Allergies.
    - ⓒ Reduces Digestive problems.

20)

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Cheese →

- ① It is one of the important dairy products which is formed by fermentation.
- ② It is

Buttermilk ↗

- ① It is a dairy product formed by fermentation
- ② Traditionally, it is made of the liquid which is remained after separating the butter from fermented cream.
- ③ In modern production, it is obtained directly from <sup>fermented.</sup> cream.
- ④ Along with direct consumption, it has a lot of other applications in cooking etc.