

## 4.2. BIOTECHNOLOGY

### SYNOPSIS

- First time Carl Ericay used the term Biotechnology
- Biotechnology is a multidisciplinary subject, based on the principles of molecular genetics, microbiology and biochemistry.
- The roots of biotechnology lie in the fermentation of food, drinks. etc.
- Curd is a fermentation product by Lactobacillus.
- Yeast is involved in the bread preparation.
- Acetone and butanol were synthesised from **Clostridium acetobutylicum**.
- During second world war penicillin was synthesized from *Penicillium notatum*.

- **“European Federation of Biotechnology: Definition :**

Biotechnology is the science of utilising the properties and uses of micro organisms or to exploit cells and the cell constituents at industrial level for generating useful products essential to life and human welfare.

- **Biotechnology in Medicine :-** Maximum benefits of biotechnology has been utilised by medical field.

Using genetic engineering technique, cloned DNAs are produced which are utilized in the commercial synthesis of hormones like insulin, interferons and vaccines (vaccines for hepatitis B virus, rabies virus, poliovirus, mouth and foot disease, small pox virus, malaria etc).

Microorganisms are commercially exploited for the production of vitamins (vitamin A, riboflavin, vitamin  $B_{12}$  etc), antibiotics (penicillin, erythromycin etc) and other commercial chemicals at low costs.

Genetic engineering technique is also used in the prevention, diagnosis and cure of many diseases by using DNA probes.

- **Interferons :** A glycoprotein produced by a virus infected host cell which will protect another cell from attack of the virus. Interferons are mostly produced by vertebrate hosts.
- **DNA Probes :** Isolated single radiolabelled DNA strands used to detect the presence of the complementary strands and are a very sensitive biological detectors
- **Biotechnology in Agriculture**  
Biotechnology has caused a revolution in agriculture through plant cell, tissue and organ culture.

## UNIT - IV :: BIO-TECHNOLOGY

Cell culture and protoplast fusion techniques have resulted in hybrid plants (through intergeneric crosses) which are generally not possible through conventional hybridization techniques. Biotechnology has also helped in the production of encapsulated seeds, disease and stress resistant plants

eg : **Bt** cotton (cotton plant with *Bacillus thuringiensis* toxin which can kill insects, beetles, flies, mosquitoes etc)

Hundreds of transgenic plants have been produced with several desirable traits like virus resistance, insect resistance, herbicide resistance, plants with improved nutritional quality etc.

eg :- A transgenic ‘Golden rice’ has been produced by introducing three genes for the production of vitamin A in ‘Taipei’ variety of rice. For better yield of crops, use of biofertilizers has become an alternative tool for synthetic chemical fertilizers. Moreover to discourage the use of synthetic pesticides, biopesticides have been commercially produced.

Bacterial biopesticide mostly used is *Bacillus thuringiensis* and viral biopesticides are nuclear polyhedrosis virus (a sub group of baculovirus) and cytoplasmic polyhedrosis virus.

- **Baculovirus :** A virus that infects arthropods, mostly the insects.
- **Biotechnology in industry :-** In this area of biotechnology, enzymes are produced commercially from microorganisms, plants and animals at industrial level.  
Animal enzymes currently used are lipase, trypsin, rennet etc.  
Most prevalent plant enzymes are papain, proteases, amylases and soyabean lipooxygenase etc. Microbial enzymes include glucose isomerase,  $\alpha$ -amylase, protease etc.  
These enzymes are used in dairy, detergents, starch, brewing, wine and pharmaceutical industries. eg:- Papain is used as meat tenderizer. Protease is a leather softener.  
Rennet is used in preparation of cheese.  
Glucose isomerase is used in preparation of artificial sweeteners, fructose syrups.  
Monosodium glutamate is used as food flavouring agent.

- **Biotechnology in food :-** Biotechnology is making a new ground in food area.  
Food biotechnology offers a valuable and viable alternative to food problems and a solution to nutritionally influenced diseases such as diabetes,

hypertension and cancer.

Biotechnology has opened up new avenues for the production of proteins from microorganisms. These microbial proteins are often referred to as single cell proteins.

Since mushrooms are known to be rich sources of proteins, vitamins, minerals and essential amino acids, commercial cultivation of mushrooms started at industrial level.

Moreover SCP and mushrooms are grown on domestic, agricultural and industrial wastes.

- **Biotechnology and Environment**

Environmental biotechnology mainly deals with the exploitation of microorganisms to reduce the environmental burden of toxic substances. Application of microorganisms couples with genetic engineering techniques will improve the quality of our environment.

Microorganisms are specially used in environmental clean up through bioremediation, utilization of sewage and agrowastes for the production of SCP, mushrooms, biogas & vermicompost.

- **Bioremediation** : The process of using living organisms to remove contaminants, pollutants and unwanted substances from soil or water is called as Bioremediation.

- **Potential of Modern biotechnology**

DNA finger printing has successfully helped the forensic science in search of criminals and also solving parentage dispute etc.

Genetherapy is hoped to solve many genetic diseases.

Presently a new field which is gaining popularity is bioinformatics, which involves the link up of biotechnology with information technology.

Bioinformatics supports the genomics and proteomics which are computer based study and designing of genome, and knowing all protein composition of organisms.

- **Bioremediation**

The process of using living organisms to remove contaminants, pollutants and substances from soil or water.

- **Proteomics**: Study of the array of protein that an organism produces by using computer is called proteomics.

- **Genomics**

Computer based study and designing of genome is called genomics.

- **Bioinformatics**

The application of information sciences to increase our understanding of Biology.

## LEVEL - I

157. Penicillin was synthesized from
  - 1) Penicillium notatum
  - 2) Clostridium
  - 3) Bacillus
  - 4) Pseudomonas
158. A glycoprotein produced by a virus infected host cell is
  - 1) Probe
  - 2) Interferon
  - 3) Antibiotic
  - 4) Hormone
159. Rare hybrids can be produced by using one of the following non-conventional methods
  - 1) Genomics
  - 2) Protoplast fusion
  - 3) Proteomics
  - 4) Bioinformatics
160. Baculo viruses mainly infect
  - 1) Annelids
  - 2) Arthropods
  - 3) Molluscs
  - 4) Protozoans
161. Transgenic Bt cotton is resistant to
  - 1) Mosquitoes
  - 2) Amoeba
  - 3) Nematodes
  - 4) Snails
162. Name the precursor rice variety responsible for the production of transgenic golden rice
  - 1) Bt rice
  - 2) Flavr Savr
  - 3) Taipei
  - 4) Brassica napus
163. Brassica napus can be directly used in hybridization as
  - 1) Male parent
  - 2) Sterile parent
  - 3) Female parent
  - 4) Bisexual parent
164. The process of using living organisms to remove contaminants, pollutants and unwanted substances from soil or water is called
  - 1) Bioinformatics
  - 2) Bioremediation
  - 3) Proteomics
  - 4) Genetherapy
165. Study of the array of proteins that an organism produces by using computer is called
  - 1) Proteomics
  - 2) Genomics
  - 3) Biopesticide
  - 4) Bioinformatics
166. Compost formation by earth worms is called by
  - 1) Biopesticide
  - 2) Baculo virus
  - 3) Vermi compost
  - 4) Green manure
167. Antibiotic synthesized during second world war was
  - 1) Streptomycin
  - 2) Penicillin
  - 3) Bacitracin
  - 4) Chloramphenicol
168. How many genes are introduced into Taipei for the production of Vitamin -A rich rice
  - 1) 1
  - 2) 2
  - 3) 3
  - 4) 4
169. The word biotechnology was coined by
  - 1) Ericay
  - 2) Brown
  - 3) Nageli
  - 4) Hooke

170. *Clostridium acetobutylicum* secretes.  
 1) Lactic acid                      2) Butanol & acetone  
 3) Penicillin                        4) Botulin
171. Bacteria used in curd formation is  
 1) *Lactobacillus*                  2) Yeast  
 3) *Clostridium*                    4) *Bacillus*
172. Roots of Biotechnology are present in  
 1) r.DNA technology    2) P.C.R technology  
 3) Fermentation technology  
 4) Chromatography technology
173. Biotechnology is based on the principles of  
 A) Molecular genetics    B) Microbiology  
 C) Biochemistry  
 1) A only                              1) A & B only  
 3) A & C only                        4) A B & C
174. Biochemical products can be synthesized at commercial level by using microbes was understood due to the synthesis of acetone and butanol from  
 1) *Clostridium butyricum* 2) *C. acetobutylicum*  
 3) *C. felsinium*                      4) *Acetobacter aceti*
175. Choose the correct set of plant enzymes produced through biotechnology?  
 1) Protease, Soyabean lipoxxygenase, Amylase and Papain  
 2)  $\alpha$ -amylase, trypsin, Soyabean lipoxxygenase, Glucose isomerase  
 3) Lipase, Trypsin and Rennet  
 4) Glucose isomerase,  $\alpha$ -amylase and Protease
176. Viral biopesticide is  
 A) *Bacillus thuringiensis*  
 B) Nuclear polyhedrosis virus  
 C) Cytoplasmic polyhedrosis virus  
 1) A only    2) A & B    3) B & C    4) A,B & C
177. Maximum benefits of Biotechnology has been utilized by  
 1) Medicine    2) Agriculture    3) Industry    4) Foods
178. Isolated single radiolabelled DNA strands used as very sensitive biological detectors are  
 1) Plasmids                              2) DNA probes  
 3) Interferons                          4) Antigens
179. Most accepted definition for biotechnology was given by  
 1) Indian Federation of Biotechnology  
 2) European federation of Biotechnology  
 3) American federation of Biotechnology  
 4) European association of Biotechnology

**LEVEL - II**

180. Which of the following are nutritionally influenced diseases  
 I) diabetes                              II) Hypertension  
 III) Cancer                             IV) AIDS  
 1) I, II    2) II, IV    3) I, II, III    4) III, IV
181. Proteomics & Genomics are supported by  
 1) Genetherapy                        2) Bioremidy  
 3) Bioinformatics                      4) Biopesticide
182. Mushroom can be cultivated on  
 I) Domestic wastes                  II) Industrial wastes  
 III) Agricultural wastes    IV) Hospital wastes  
 1) I & II                                      2) II, III  
 3) I, II, III, IV                            4) I, II, III
183. Assertion (A) : A genome refers to the haploid set of chromosomes  
 Reason (R) : Computer based study of genome is called genomics.
184. Assertion (A) : Microorganisms play an important role in Bioremediation  
 Reason (R) : Living organisms play an important role in the removal of contaminants, pollutants etc from soil.
185. Assertion (A) : Biotechnology is a multidisciplinary subject  
 Reason (R) : Biotechnology is based on the principles of molecular genetics, microbiology and Biochemistry
186. Assertion (A) : Biotechnology is also useful in identifying criminals.  
 Reason (R) : DNA finger printing helps forensic science in search of criminals.
187. Assertion (A) : Many enzymes are produced commercially from animals utilizing the techniques of Biotechnology  
 Reason (R) : Lipase, Trypsin, Rennet etc. are animal enzymes produced on commercial scale with help of Biotechnology.
188. The resultant problems of population breakout can be solved upto some extent by involving the applications of  
 1) Biotechnology                      2) Cytogenetic  
 3) Molecular genetics                4) Genetics
189. Among the following which is considered as the unrelated branch of knowledge for biotechnology  
 1) Microbiology                        2) Molecular genetics  
 3) Biochemistry                        4) Environmental biology
190. Assertion(A): Biotechnology helps in the production of transgenic plants containing desirable genes.  
 Reason (R) : Taipei variety rice with Vitamin-C is transgenic plant

191. Assertion (A) : *Bacillus thuringiensis* is a bacterial biopesticide  
Reason (R): Sometimes crop yield is increased by employing microorganisms that kill insects.
192. Assertion (A) : *Bacillus thuringiensis* is used as bioinsecticide  
Reason (R) : Bioinsecticides are produced by using glucose isomerase
193. Biotechnology in Agriculture is concerned with the development of varieties like  
I. Insect resistant                      II. Virus resistant  
III. Herb resistant                      IV) Herbicide resistant  
1) I & II only                      2) II and III only correct  
3) All are correct except III  
4) I & III are correct
194. Identify incorrect statement :  
1) Principles of Biotechnology are used in SCP production  
2) Rennet is used in preparation of artificial sweeteners  
3) Monosodium glutamate is used as food flavouring agent  
4) Glucose isomerase is one type of microbial enzyme
195. Microbial enzymes are  
A) Glucose isomerase    B)  $\alpha$  - amylase  
C) Protease                      D) Papain  
1) A & B only                      2) A & B only  
3) A, B & C                      4) A, B, C & D
196. Assertion (A) : Microbial enzymes are useful in many industries  
Reason (R) : Protease is a meat tenderizer
197. Biotechnology in medicine is concerned with the synthesis of  
I. Hormones                      II. Interferons  
III. Vaccines                      IV. Vitamins  
1) I and II only                      2) I, II, III only  
3) I, III, IV only                      4) I, II, III & IV
198. Identify the wrong statement  
1) Carl Ericay for the first time used the term Biotechnology  
2) Biotechnology is a multi disciplinary subject  
3) *Lactobacillus* is employed in making of curd  
4) Acetone and butanol are synthesized from *Clostridium tetani*

**LEVEL - III**

199. Choose the correct pair  
1) Glucose isomerase - microbial enzyme  
2) Hypertension-Produced through biotechnology  
3) Monosodium glutamate - Leather softner  
4) Protease – Plant and microbial hormone
200. Identify wrong statement  
1) Baculo virus mostly infects insects  
2) Mushrooms are sources of proteins, minerals, vitamins and essential amino acids  
3) Computer based study of genome is called Bioinformatics  
4) Interferons are glycoproteins produced by virus infected host cell
201. Identify correct statement  
1) Amylase is a plant enzyme  
2) Biotechnology does not help in the commercial production of microbial enzymes  
3) Bt cotton is not resistant to mosquitoes  
4) NPV is bacterial biopesticide.
202. Find out the correct statement among the following  
1) Interferons are alkaloids that help in killing weeds  
2) DNA probe is a single radiolabelled DNA strand used as biological detector  
3) DNA probe is a radiolabelled ds DNA strand used as biological detector  
4) Golden rice has been produced by introducing three genes for the production of Vitamin-D
203. Identify the wrong statement :  
1) Bioinformatics refers to the application of information sciences to increase our understanding of Biology  
2) Study of the array of proteins that an organism produces by using computer is called proteomics  
3) The process of compost formation by microorganisms is called vermicompost  
4) Papain is used as meat tenderizer
204. The science of exploiting microbes for welfare on industrial scale is called  
1) Biotechnology                      2) Microbiology  
3) Molecular biology                      4) Biochemistry