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CHAPTER NOTES

Biotechnology and Its Applications

Class 12 Notes — CBSE Biology

Chapter 12

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Biotechnology and Its Applications Class 12 Notes — CBSE Biology Chapter 12

Chapter 12 — **Biotechnology and Its Applications** — covers applications in agriculture (Bt crops, Golden Rice), medicine (gene therapy, insulin), and related ethical/biosafety issues. Carries **5-7 marks**.

Key Concepts

Applications in Agriculture

Bt Crops

Bt toxin gene from *Bacillus thuringiensis* is transferred to crop plants

Gene produces **Cry protein** (crystalline protein) → toxic to specific insect larvae

Cry protein is inactive in bacteria → becomes active in insect gut (alkaline pH) → creates pores in gut → insect dies

Cry1Ac, Cry2Ab: Bt cotton (against cotton bollworm)

Cry1Ab: Bt corn (against corn borer)

RNA Interference (RNAi)

dsRNA (double-stranded RNA) silences a specific mRNA → gene is switched off

Used to create nematode-resistant tobacco: host produces specific dsRNA → nematode ingests it → nematode's mRNA silenced → parasite cannot survive

Golden Rice

Rice biofortified with **β-carotene** (provitamin A) by introducing genes from daffodil and bacteria. Addresses Vitamin A deficiency.

Applications in Medicine

Genetically Engineered Insulin

Humulin: Human insulin produced in *E. coli*

Eli Lilly (1983) — first commercially produced rDNA product

Human insulin has 2 chains: A (21 aa) and B (30 aa) linked by disulphide bonds

Proinsulin → C-peptide removed → active insulin

Gene Therapy

First successful: **ADA deficiency** (Adenosine Deaminase — needed for immune function)

Lymphocytes collected from patient → functional ADA gene inserted using retrovirus vector → cells returned to patient

Not permanent cure — needs repeated treatment unless bone marrow cells are treated

Molecular Diagnostics

- **PCR:** Amplify pathogen DNA for detection (HIV, TB, etc.)
- **ELISA:** Antigen-antibody interaction → detect infection
- **DNA probes:** Hybridise with specific pathogen DNA

Transgenic Animals

- **Rosie:** First transgenic cow — produced human α -lactalbumin-enriched milk
- Uses: study gene regulation, test drug safety, produce biological products

Ethical Issues — Biopiracy

- **Biopiracy:** Unauthorised use of bioresources/traditional knowledge by corporations
- Examples: Neem (W.R. Grace), Turmeric (wound healing patent — revoked), Basmati rice (RiceTec patent)
- **GEAC (Genetic Engineering Approval Committee):** Indian regulatory body for GMO trials and release

Quick Revision Points

- Bt crops: Cry protein (from *B. thuringiensis*) → kills insect larvae; Bt cotton uses Cry1Ac/Cry2Ab
- RNAi: dsRNA silences specific gene → nematode-resistant tobacco
- Humulin: human insulin from *E. coli* (Eli Lilly, 1983)
- Gene therapy: ADA deficiency — first example; lymphocytes + ADA gene via retrovirus
- Rosie: first transgenic cow (human α -lactalbumin in milk)
- Golden Rice: β -carotene enriched
- Biopiracy: neem, turmeric, basmati cases
- GEAC: regulatory body for GMOs in India



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