Biotechnology

Biotechnology is the accumulation of more than 8000 years of human experience using living organisms and the process of fermentation to make products. Today biotechnology is applied to manufacturing processes used in health care, food, agriculture, industrial and environmental cleanup, among other applications. In **1919, Karl Ereky**, a Hungarian engineer, coined the term biotechnology for the first time to describe the interaction of biology and human technology.He envisioned a new era of technology based on using biology to turn raw materials into socially useful products.Nearly a century later, vision is being realized by thousands of companies and research institutions.Biotechnology composes of **Bio** that refers to the use of biological processes, and **technology**that refers to solve problems or make useful products.

A widely accepted definition of **Biotechnology** is "Application of scientific and engineering principles to processing of materials by biological agents to provide goods and service". Some other definitions replace rather ambiguous word **'biological agents'** with more specific words such as microorganisms, cells, plant and animal cells and enzymes. When a biotechnological process is implemented on a commercial scale there is every reason to believe that it will make in some **bioreactor or fermenter**.

Biotechnology is the use of living systems and organisms to develop or make useful products. Or its any technological application that uses biological systems, living organisms or derivatives thereof, to make or modify products or processes for specific use.

Historical development of biotechnology

1- Stage1:Pre-Pasteur Era(before 1885)

- Discovering of microorganisms
- Traditional microbial industry(bread, cheese, beer and wine)

2- Stage2:Pasteur Era or fermentation Era(1885-1940)

- Production gunpowder by soil microorganisms
- The fermentative ability of microorganisms
- Production of chemicals like acetone, butanol, ethanol and organic acids

3- Stage3:Antibiotic Era(1940-1960)

● Production of antibiotics

● Production ofenzymes and vitamins

● Production ofgibberellins ,amino acids, nucleotides and steroids

●Tissue cultures techniques

4- Stage4:Post-antibiotic Era(1960-1975)

●Production of single cell protein (SCP)

●Production of sterilantsanddisinfectants

●Enhancement of microorganisms productivity by genetic engineering techniques

5-Stage5:Genetic engineering Era(1975-2000)

● Production of therapeutic proteins(insulin, interferon,....etc)

●Production of new sources of energy(Biogasand biodiesel)

● Production of monoclonal antibodies

● Production of hybrid antibodies

● Production of biodetergents

●Immobilization of enzymes and cells

6-Stage6:Transgenic organisms Era(2000-2025)

●Production of vaccines by plants

●Production of therapeutic proteins by animals

●Production of genetically modified foods.

●Production ofartificial chromosomes

Another division for biotechnology was included:

1) **Ancient Biotechnology (stage I)**

2) **Classical Biotechnology (stages II , III and IV)**
3) **Modern Biotechnology (stages V and VI)**

Some important discoveries related to biotechnology have been shown in Figure 1.

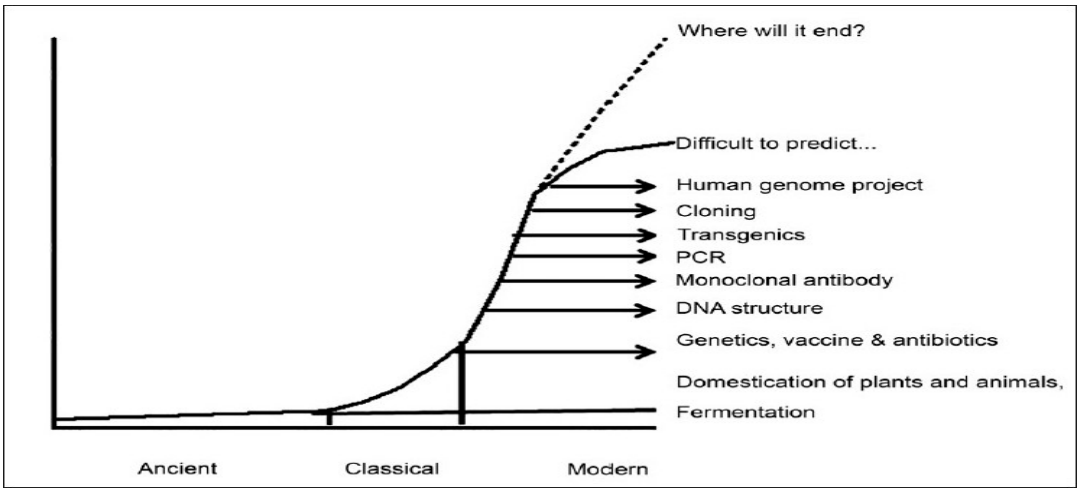

Figure 1:History of the development of biotechnology. Some of the important biotechnology discoveries have been plotted in this graph, with a possibility for its unlimited growth in the future.

Generations of biotechnology

1- **Blue biotechnology:** is a term that has been used to describe the marine and aquatic applications of biotechnology.

2-Green biotechnology:is biotechnology applied to agricultural processes.

3-Red biotechnology:is applied to medical processes.

4- White or grey biotechnology: is biotechnology applied to industrial processes or environment**.**

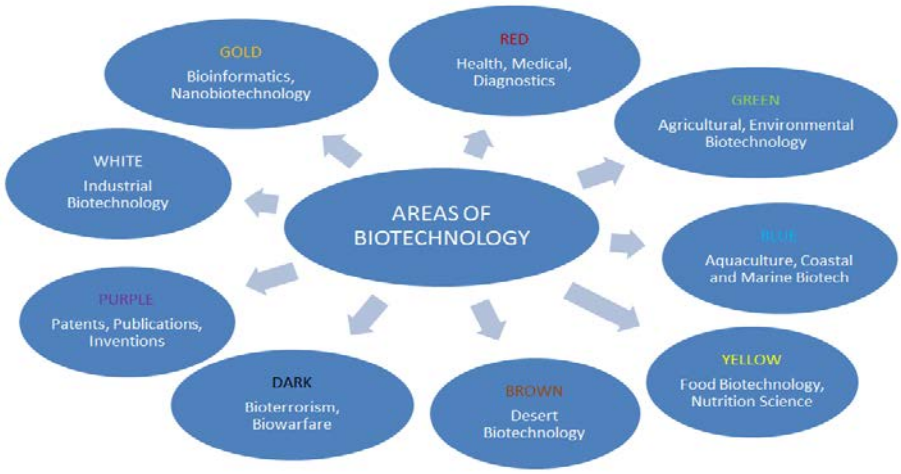

Figure 2: Generations of biotechnology

Biotechnology inputs

1-Monoclonal antibodies

Usingimmune system cellsthat buildantibodieswhich are characterized byveryhighly specializedand therefore candetermineand discover thevital elementsaccuratelyeven ifverysmall quantities, and its applications**:**

●Identify anddetectenvironmental pollutants.

●Todetectharmfulmicroorganismsinfood.

● differentiatebetweennormal cellsandcancer cells.

2- Tissue culture technology

It isthe cultivationof animal or plantcellsin vitro(in the laboratory), and their applications:

●Cellular therapy.
●the production ofdrugsfromplantcellsdirectly insteadof the plant.
●The use ofanimal cellsin the detectionefficiency ofdrugsinstead ofanimals, reflecting the safetyand accuracy.
●Propagationanddoubled of the plant tissuesin the laboratory.

3- Cloning

Production numbers and models of genetically identical molecules, cells and animals and plants which are of three types: Molecular or DNA cloning, cells cloning and animal or reproductive cloning.

4- Genetic modification

It happensto modify thegenes ofthe same typeorthe transfer ofgenesfrom one species toanother andits applications**:**

●Production ofdrugs and vaccines.
●Treatment of certaingenetic diseases.
●To increase agricultural productionand reducecost.
● Increasethe value ofthe nutritional contentinfood**.**

5- Protein engineering

This technique dependson the concept ofgenetic modificationin order toproducespecific proteinsornew proteinshaveuseful applicationssuch asenzymesorbiocatalysts.

6- Hybrid technology

It is intended to link biological sciences with other sciences to give useful applications such as:

a- Biosensors

This technologyconnectsbetween**biology andmicroelectronics**, and their applications:
•measuring thecontentand quality offoodand safety.
•measurement ofenvironmental contaminants.
•helping doctorsto measurespecific componentsin the blooddirectly**.**

b-Tissue engineering

This technology connects between **cytology and materials science** to produce artificial tissues in the laboratories with its scaffolds. The successful examples of this technique the building of skin and cartilage.

c-DNA chips

This technologyconnectsbetweenthe **semiconductor industryandthe genes**making it possible toanalyzetens of thousands ofgenesina single-chiparea does not exceedper squarecentimeter, and their applications:
●detection ofmutationsinspecific genes.
●measurement ofgene activity.
●Identification ofgenesimportantfor crop production.
●Studying thestructuralsequenceof genetic material**.**

d- Bioinformatics

Thistechnology linkbetween**computer scienceand the genetic material,**especiallythe programsof statistical analysis, graphsimulation and databases and thatutilizedin the analysis ofthe vast amount ofinformation derived fromgenetic material, and their applications:
•Geneticmappingand identification ofsitesandthe number of genesineachmap.
•determination of the shapeandconstruction ofproteins.
•Simulation theway ofproteins workandthread.

•The discovery ofthe causesand locations ofgeneticmaladiesanddesignappropriate treatment.

Hybrid technology

- Biology + Microelectronics=Biosensors
- Cytology + Materials = Tissue engineering
- Genes + Semi conductive = DNA chips
- Genetic material + Computer science = Bioinformatics

Figure 3:Hybrid technology

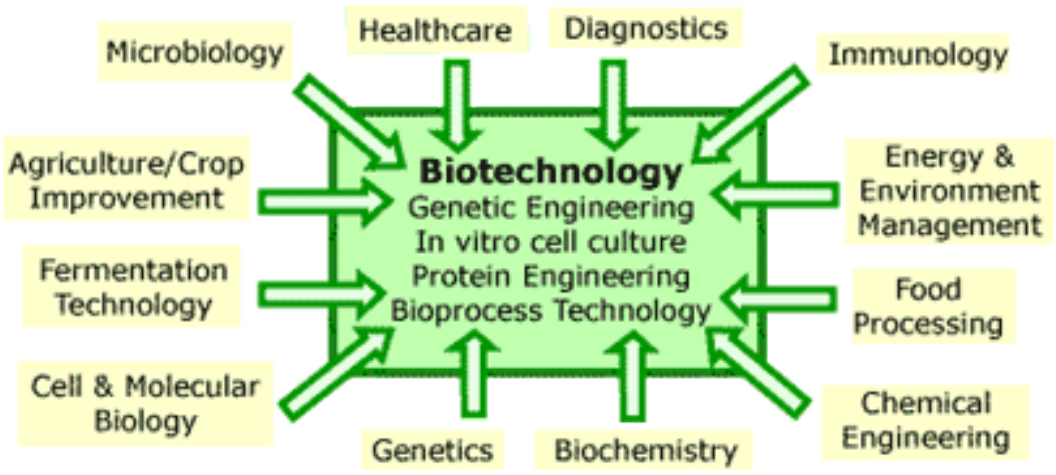

Figure 4: Inputs of biotechnology

Biotechnology outputs

1-**Outputsin the medical field**: The most important outputsareas ofmedicalbiotechnologyare:
•The treatment of certaindiseasessuch as cancer.
•The production ofvaccines andimmunizations.
•Diagnosis ofdiseases.
•Gene therapy.
•Stem cell research.
•Production of proteinsand genes

2-Outputs ofthe agricultural field: The most importantoutcomesinthis area are:
•Food production,such as geneticallymodified foods.
•Hybridizationbetweenplantspecies.
•Production of Biocides.
•Natural protectionfor plants.
• Production offood additives.
•Reducing the use ofherbicides.

•The production ofdrugsandmedicinesfor the treatment ofanimalswhich usedas foodforthe people.

3-I**ndustrial outputs**:
An enzymesarethe most important outputsin this area andthere are currentlymore than450enzymeworksas a catalystin variousindustrial applications, such as: carbohydrases, proteases, peptidases, lipases, oxireductases and transferases.

4-**outputs inthe environmental field**:
Some techniques are used for removingof pollutants from an environmentand usefulthing is thatgenetically modified organismsare usedfor this purposecan be leftto livenaturally in the environment, especially places ofcontaminants andin turnwithout a problemoran additional cost, and examplesrid thegasolinefrom a substanceMethyl tertiary butyl ether (MTBE)usingbacteria, are also usedinbiotechnologyto get rid from the remnants ofthe oilin thereservoirsof oilinthe Gulf states.

5-For aerospace applications:
The U.S. space agencyNASAin 2000 signed agreement with thebiotechnology industryOrganizationandthe NationalInstitute of Cancer Researchfor the use ofbiotechnologyinspace exploration, as well as micro-gravity research.

6-Other uses:
Biotechnologyapplicationsexceeded thekey areasmentionedearlierhavetoother areas such as:
•Aquaculture

•Fingerprinting
•Criminaltests

•Establish paternity

•Anthropology

•Biologicalweapons