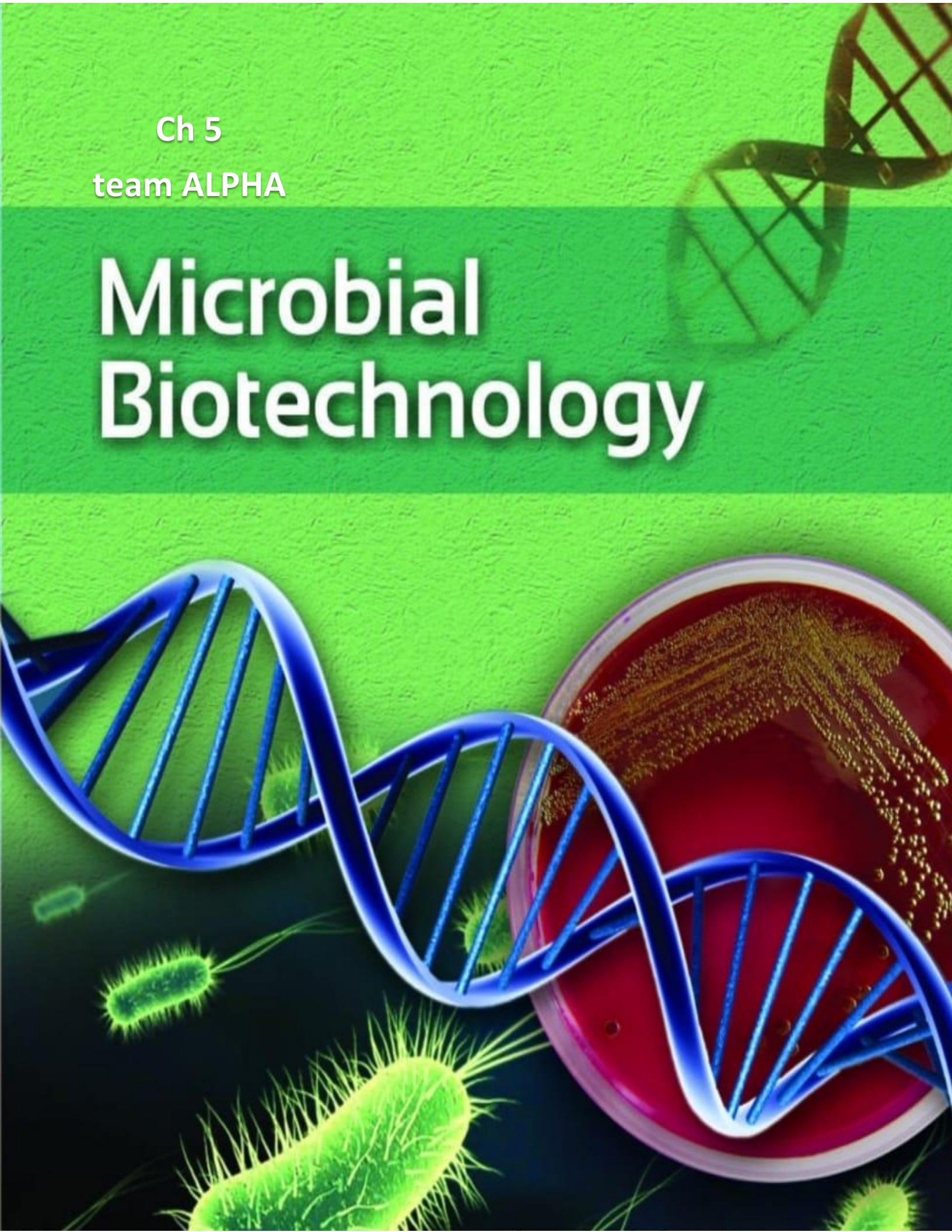
Ch 5

team ALPHA

Microbial Biotechnology



Microbial biotechnology

Microbes (microorganisms) are tiny organisms that are too small to be seen individually by the naked eye and must be viewed with the help of a microscope.

• microbes are: Bacteria, fungi, algae, and protozoa

• Bacteria were the first life forms on earth and have existed for over 3.5 billion years, and are estimated to comprise over 50% of the earth's living matter

We are surrounded by bacteria.

• They live in our mouths, on our skin and in our digestive tract.

• There are approximately 10 times as many bacterial cells in the human body, than our own cells!

• Bacteria are adapted to living in some of the harshest environments on the planet: Polar ice caps, deserts, boiling hot springs and under extraordinarily high pressure in deep-sea vents miles under the ocean's surface

Humans have long used microbes in traditional biotechnology' and microbes are central to recombinant DNA technology

• Two exciting areas of microbial biotechnology are 'biofuels' and 'synthetic biology'

• Less than 1% of all bacterial species have been identified, cultured and studied, so we can only imagine the contribution of microbes to biotechnology in the future

The Structure of Microbes

• Eukaryotic microbes include yeast, algae and protozoans

• Prokaryotes are single celled microorganisms which include the domains Bacteria and Archaea

• Archaea share properties of both eukaryotes and prokaryotes

• They live in extreme environments and have unique metabolic properties

• Those living in salty environments are called 'halophiles' and those living in hot environments are called 'thermophiles'

• Structural Features of Bacteria

• Small (1–5 µm)

• No nucleus; DNA is contained in a single, circular chromosome

• May contain plasmids

• Cell wall that surrounds plasma membrane contains peptidoglycan; provides rigidity for protection

• Some bacteria contain an outer layer of carbohydrates in a structure called a capsule

•Bacteria are classified by the Gram stain

•Gram + bacteria stain purple

• Have simple cell walls rich in peptidoglycan

•Gram – bacteria stain pink

• Have complex cell wall structures with less peptidoglycan

• Single, circular chromosome is relatively small
2–4 million base pairs

• Some bacteria contain plasmids as well

• Plasmids often contain genes for antibiotic resistance and genes encoding proteins that form connecting tubes called pili which allow exchange of genetic information between cells.

- Plasmids are an essential tool for cloning
- Bacteria grow and divide rapidly ,Divide every 20 minutes or so

• Millions of cells can be grown on small dishes of agar or in liquid culture media

• Easy-to-make mutant strains to be used for molecular and genetic studies

• Yeast

- Can grow in the presence of oxygen (aerobic) or in the absence of oxygen (anaerobic)
- Pichia pastoris
- Grows to a higher density in liquid culture than other yeast strains
- Has a number of strong promoters that can be used for production of proteins

- Can be used in batch processes to produce large number of cells

Microorganisms as Tools

• Microbial Enzymes

- Used in applications from food production to molecular biology research

• Taq DNA polymerase

- Heat stabile, isolated from a thermophile

• Cellulase

- Makes animal food more easily digestible
- Stone-washed jeans

• Subtilisin

- Laundry detergents

• 'Bioprospecting', the discovery and development of new products from biological resources, promises to unearth other valuable microorganisms

The microorganisms have been used as a tool for the production of useful protein for example microbial enzyme and the microbial enzyme as we said before have been used for:
1- production of food

2- detergent industry

3- chemical industry

4- in research or in diagnoses

For example we have the taq polymerase that is extracted from thermophile bacteria because it is heat stabile so we can use it for amplification of DNA in PCR

Also we have cellulase that are used to make certain types of juices, in jeans industry, to prepare animal food

Scientists are always looking for the discovery or development of new product from microbes that's why scientist are always trying to isolate novel microbes that could be producing useful enzymes

Bioprospecting: describe the discovery and development of new product from newly discovered microorganism

One of the major applications of microorganism is the ability to use as a host cell that can accept foreign DNA

Recombinant DNA technology was developed because of the use of bacteria as a host cell

• Transformation – the ability of bacteria to take in DNA from their surrounding environment

Bacteria will naturally take up DNA, plasmid from the environment.

Other types of bacteria cannot do that and here become the use of genetically engineered to accept the foreign DNA

- In biotechnology, cells are treated so that they become competent and are able to take up DNA more easily.
- Transformation of competent cells is used to introduced recombinant plasmids into cells so the bacterial can replicate these plasmids.
- This process is called transformation because one can "transform" the properties of bacterial cells by introducing foreign genes
- • There are two methods for transformation commonly used in biotechnology:

1. The 'calcium chloride' method involves treatment of cells with ice-cold solution of calcium chloride followed by a brief 'heat shock'

2. Electroporation uses a brief electrical shock to introduce DNA into cells

• **Calcium Chloride Transformation**

• Target DNA is introduced into a plasmid containing one or more antibiotic resistance genes

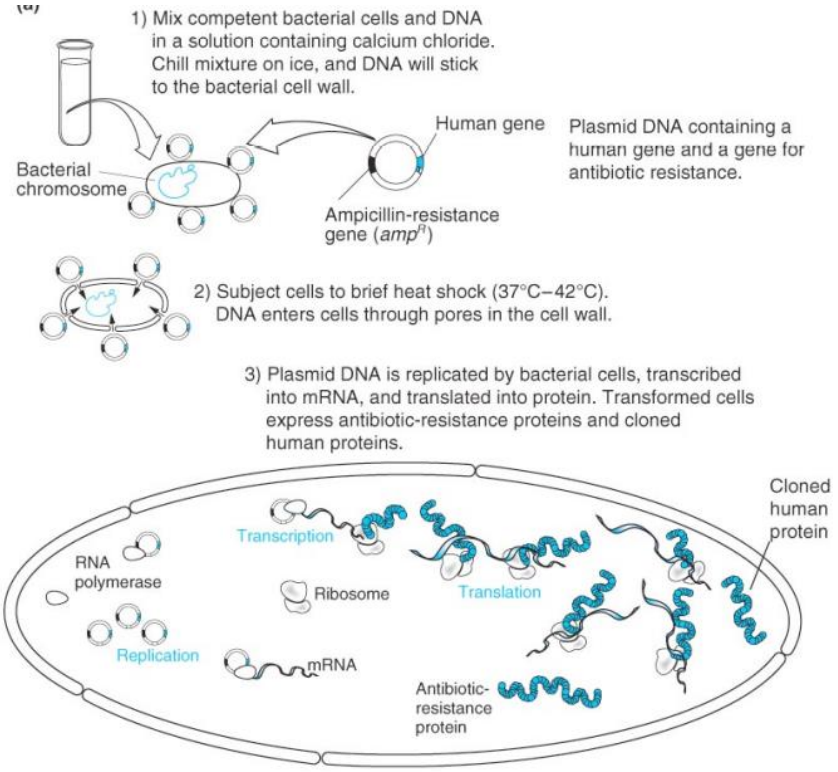
• Plasmid vector is mixed in a tube with competent cells and placed on ice

• Cells are heated briefly (heat shock) to allow DNA to enter cell

• Grow in liquid media

• Plate on agar plates containing antibiotics

• Only cells which have taken up the plasmid will be able to divide and produce colonies



• The exact mechanism for transformation is not understood

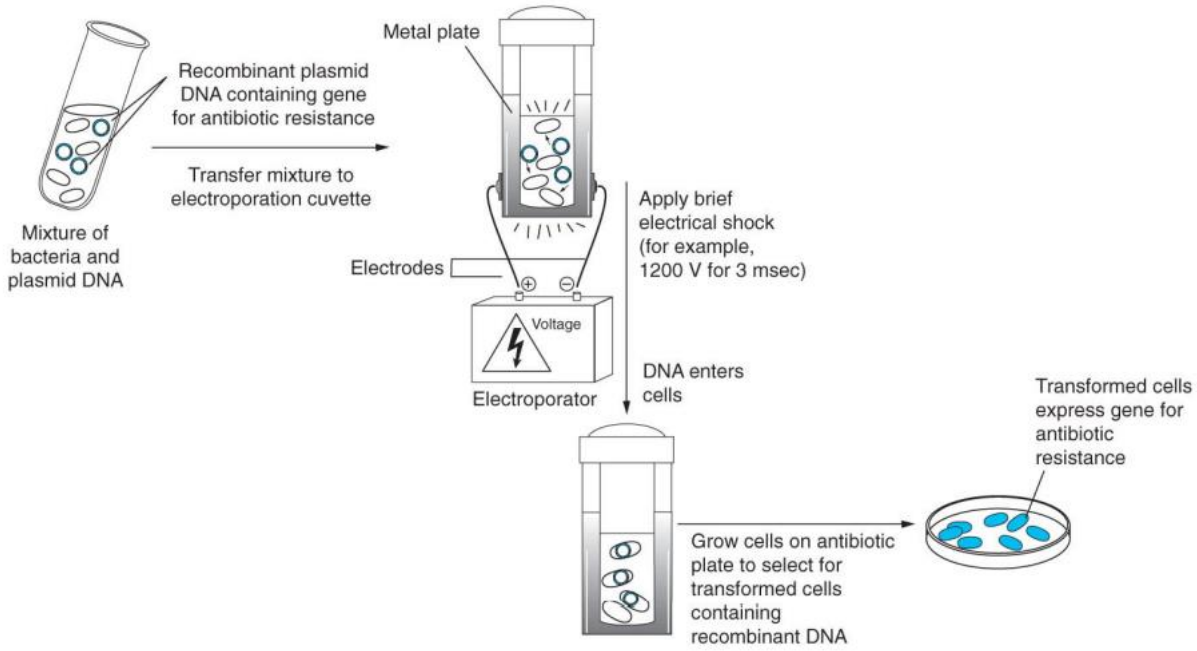
• It is thought that when the cells are cold, DNA will stick to them and the cold creates gaps in the membrane that allow DNA to enter the cells when they are heat shocked

• **Electroporation**

• An instrument called an electroporator produces a brief electrical shock that introduces DNA into the cells without killing them

• Advantages

- Rapid
- Requires fewer cells
- Can be used to introduce DNA into other cell types
- More efficient process



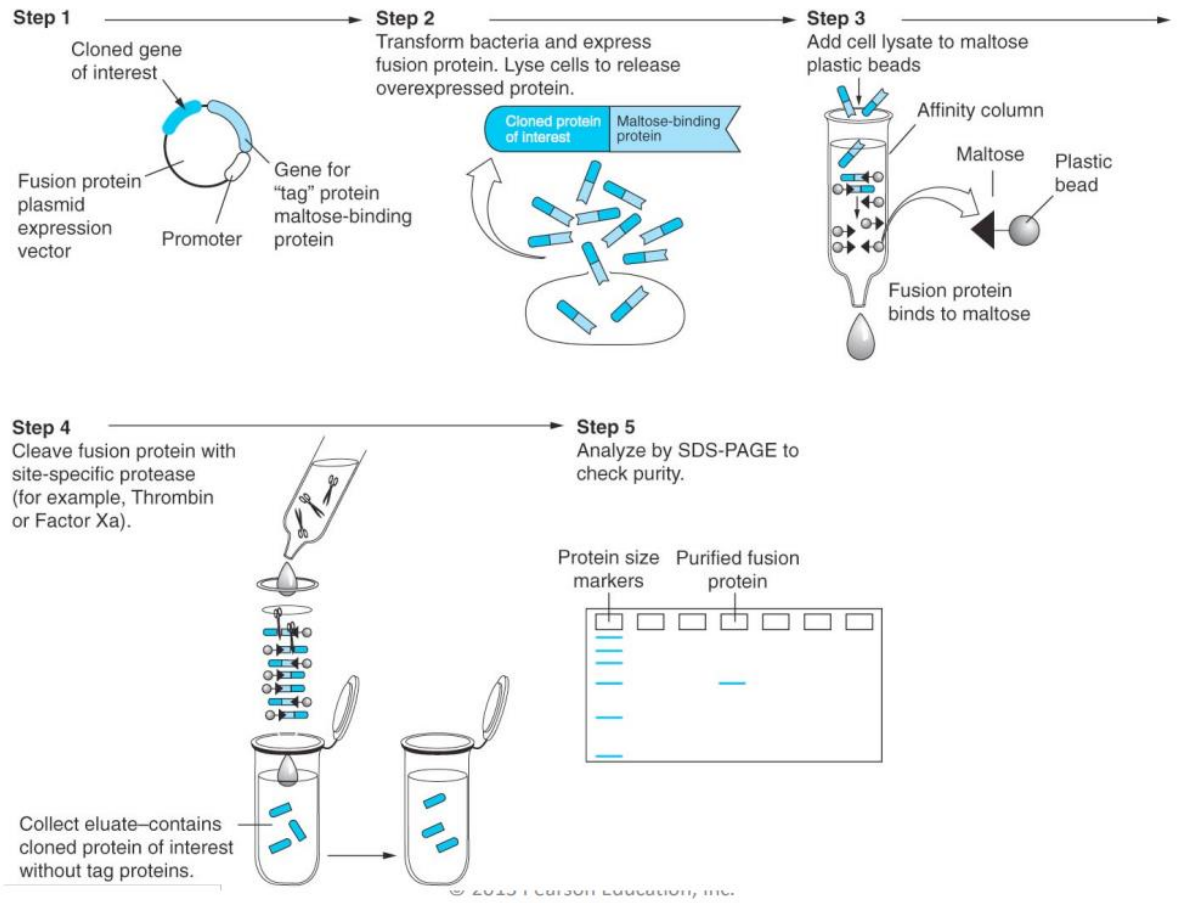
• Bacteria can be used to mass-produce proteins

• A useful way to express proteins that can be easily purified for use is to create **fusion proteins**

• The gene for protein of interest is cloned into a type of protein known as an expression vector which has a gene for the "tag" protein downstream of a promoter

• The gene for the protein of interest and the "tag" protein are expressed as a fusion protein which then can be purified by a technique called **affinity chromatography**

- One of the major to use bacteria to produce protein is the ability to produce large amounts of proteins also the ability to produce fusion protein
- The fusion protein as we said before is produced from a plasmid carrying two coding sequences protein, and these two sequences are fused together now the are different reason why we produce protein as fusion protein one of them is to allow easier purification, another reason is that if we want to produce a human protein in bacterial cell we will express it outside of its normal cell so the fusion protein help in the folding of the protein inside the bacterial cell



Maltose-binding protein→ tag

Tag + coding protein→ fusion protein

bead inside affinity column that will have in surface of it maltose this why it is called maltose binding protein now any other protein that is not bound to the maltose binding protein will be gone because the maltose binding protein will be bound to the protein of interest so also the protein will bind to the surface of the bead this will help in the purification

then we remove the maltose binding protein from our protein by digestion(by use protease) the coding sequence of our gene and the coding sequence of the tag will produce a couple peptide and

these peptide consist of amino acids so the protease can recognize them and will cut only the tag

• Microbial Proteins as Reporters

Reporters are genes that could be cloned, and they could report for us something we want to know

For example the blue-white selection where we use the lacz that encode B-galactose are example for reporter, these gene will allow us to know if the cloning was successful or not

• Bioluminescence – method of producing light used by marine organisms

• Created by bacteria such a Vibrio fisheri that use marine organisms as a host

• Create light through action of lux genes

Another reporter gene is the lux gene where utilized from a bacteria called vibrio fisheri that live in marine organisms

These genes allow the detection of the bioluminescence

The pyrosequencing utilizes one of the product encoded by lux gene

So luciferase which is encoded by lux gene could be used as reporter, when we supplies the luciferin with the present of ATP and o2 luciferase convert luciferin into oxyluciferin during this process light or bioluminescence is produced

- Bioluminescence produce light through action between biological molecules
- Chemiluminescence produce light due to chemical reactions

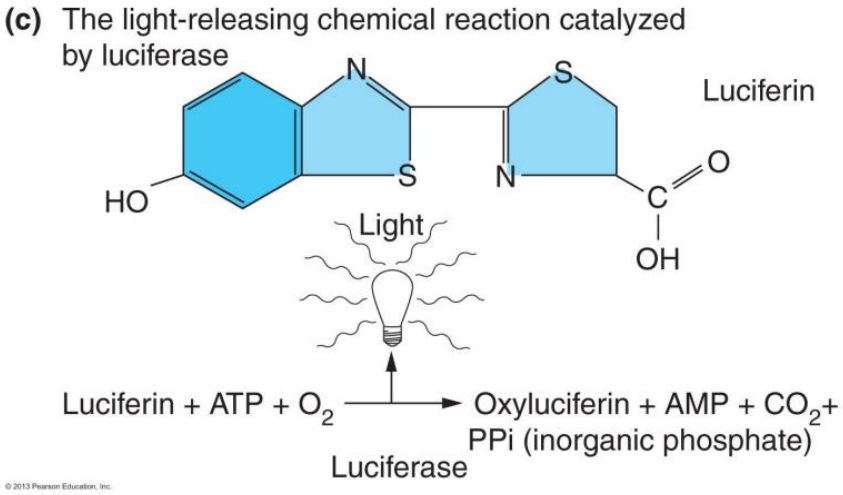
• Lux genes have been cloned and used to study gene expression

• Clone lux genes into plasmid

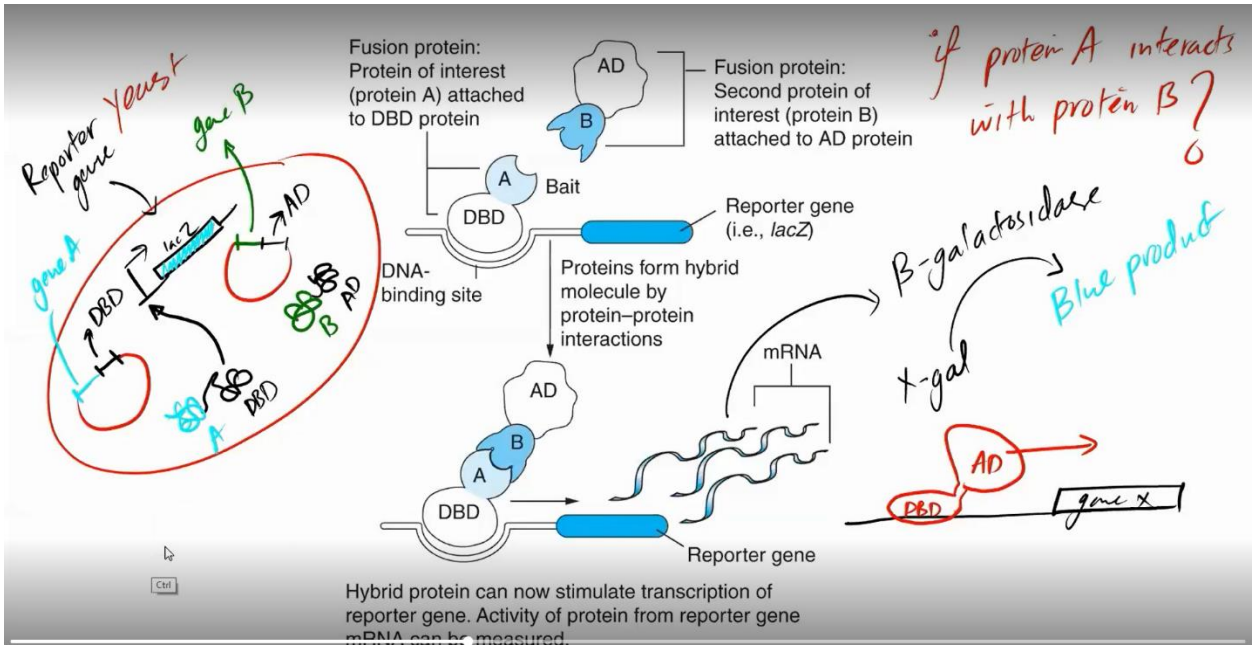
• If inserted into animal or plant cells, will produce luciferase and will fluoresce, providing a visual indicator of gene expression

• Lux genes have been used to develop a fluorescent bioassay to test for tuberculosis

So for example if we want to study the expression using reporters genes, lets say we want to study the expression of gene x we will fuse the promoter of gene x with lux gene if the gene x is expressed that mean the promoter is on and attached to gene x, but if we get luciferase that mean the promoter will be on and attached to lux gene



- **The Yeast Two-Hybrid System**
    - From its name it involves the use of yeast
    - Yeast are microbial organism but eukaryotic
    - Used when scientist want to know if two protein interact with each other or not
    - One way of studying the protein function is determines which type of protein interact with each other. This system relies on the DNA cloning and the using of plasmid
    - One of the major function of the protein inside our cells is to bind to something (lipid, DNA,…)
- Two fusion proteins are created
    - One is a fusion of a DNA binding domain (DBD) of a protein such a transcription factor with protein 'A'
    - The second is a fusion of an activator domain (AD) from a transcription factor and protein 'B'
- If protein 'A' and 'B' interact, the DNA binding domain and the activator domain will be brought together, making a functional transcription factor, which interacts with the promoter for a reporter gene, such as lacZ, that be expressed



now the purpose of this technique is to answer the question, does protein A interact with protein B ?

To answer that we have first to clone the coding sequence A and B and fuse the coding sequences with another protein

So gene A for example can be fused with the coding sequence of transcription factor domain called DBD

Also the gene B will be fused with coding sequence of transcription factor called AD

So this system require the two fusion protein

Transcription factors are protein that can bind DNA to active the expression of gene

Now the transcription factor consists of two parts

1- DBD→ the part of transcription factor that will be responsible for the binding of DNA
2- AD→ activation domain

The two parts can be separated and still be function

So, inside the yeast we will have two plasmid carrying fusion protein and after the expression we will end up with protein B and AD, also we will end up with protein A and DBD

Now as we said the two protein will be produced inside the yeast cell but the yeast can also contain another reporter gene for example they could contain lacz, lux gene, this reporter gene its transcription depends on AD,DBD domains that are fused to A and B gene

Now DBD by itself can't active the transcription of lacz and, AD by itself can't active the transcription of lacz, so both proteins must bind to promoter region of reportore gene to be expressed and this only happen if protein A and B interact with each other

So, what will happen is that protein A will interact with protein B, this will cause the AD and DBD get close to each other

Now after the interaction between A and B the DBD and AD will be located at the promoter of the lacz gene and the transcription will start and we will get mrna, the mrna will be translated to produce B-galactosidase enzyme, now if we add x-gal the x-gal will be converted to produce blue color in the presence of B-galactosidase so the color of the cell will change to blue and by this way we can answer the question

of course, if no interaction happen no translation will happen to the lacz gene

now in the same way if we want to discover the interaction between new discovered protein and other proteins inside the cell we will use the same technique, so the newly discovered protein will bind to AD or DBD

Using Microbes for a Variety of Everyday Application

Food Products

• Microbes are used with traditional and modern biotechnology to make many foods, including bread, yogurt, cheese and alcoholic beverages

After the development of recombinant DNA technology microbes were utilized to make recombinant product

• The first recombinant DNA food ingredient approved by the Food and Drug Administration (FDA) is a recombinant form of an enzyme that is used to make cheeses

• Curds to make cheeses are made traditionally from rennin, an enzyme which is extracted from the stomach of calves

• **Chymosin**, is a rennin that was cloned and expressed in bacteria and is less expensive and easier to produce

Chymosin is a rennin enzyme, the coding sequence of chymosin was cloned and expressed in bacteria and the chymosin protein will be extracted from the bacteria and will be used in cheese industry

So now we don't have to relay on the rennin that is extracted from the stomach of cows because now we can produce it in large quantities, and it will be less expensive by the recombinant DNA technology

• **Fermentation** – process of deriving energy from sugars in the absence of oxygen(metabolize sugar to produce energy)

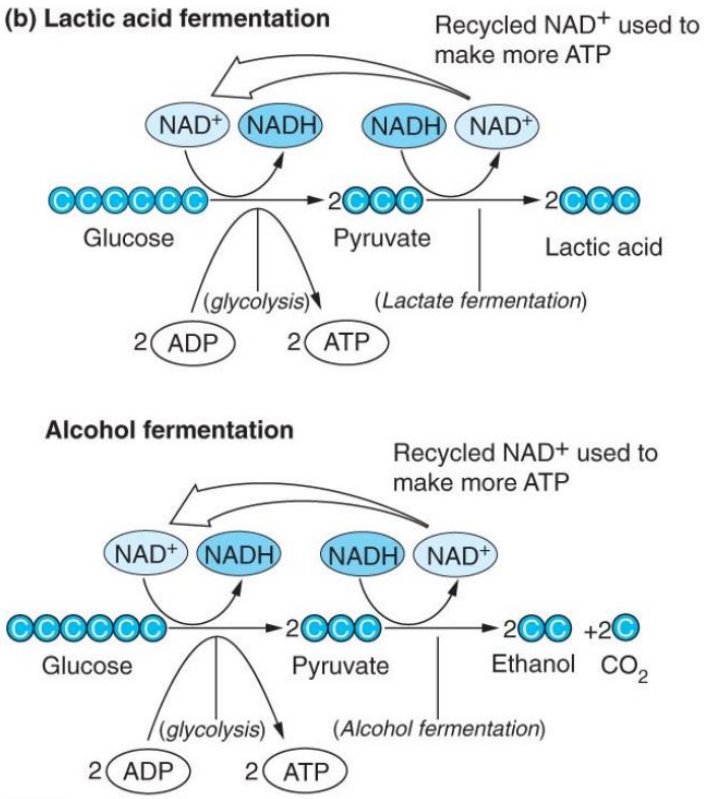
Note:

Cellular respiration require oxygen

We have two major types of fermentation

1. **Lactic acid fermentation:** used to make yogurt, sour cream, sauerkraut, vinegar and certain cheese and breads.
2. **Alcohol fermentation**: used to make beer, wine, champagne

Remember the process of growing large quantities of microbes in large fermenter is also called fermentation, but here we are talking about the biochemical reaction not the growing process



Now the lactic acid that result from the lactic acid fermentation by the addition of different substances we will get different product for example if we add milk we will get yogurt, by the addition of yeast we will get bread

Therapeutic Proteins

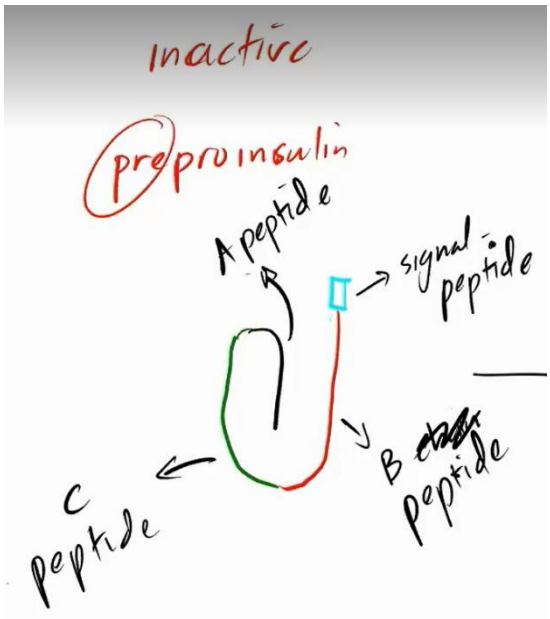
Microbes can be used to produce therapeutic protein

• Bacteria are used to produce medically important proteins

• Insulin, the first recombinant molecule expressed in bacteria for use in humans is an excellent example

Insulin is a hormone protein

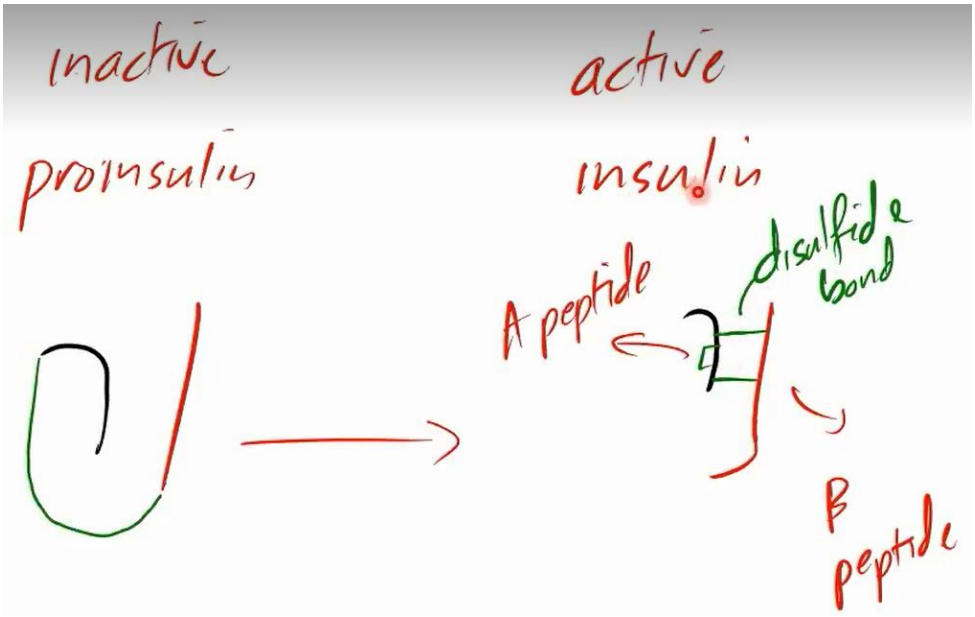
- Insulin is produced in pancreatic cells encoded by insulin gene, when the insulin gene is expressed a protein will be produced and this protein is called preproinsulin, this protein will be inactive and this protein is a single polypeptide



As we said this protein will be produced inside the pancreatic cells and it must be secreted out the pancreatic cell into the blood

Now when the protein produced the four domain will still be connected together

The single peptide allow the protein to be secreted outside the cell, once the protein is outside the cell the peptide signal will be removed

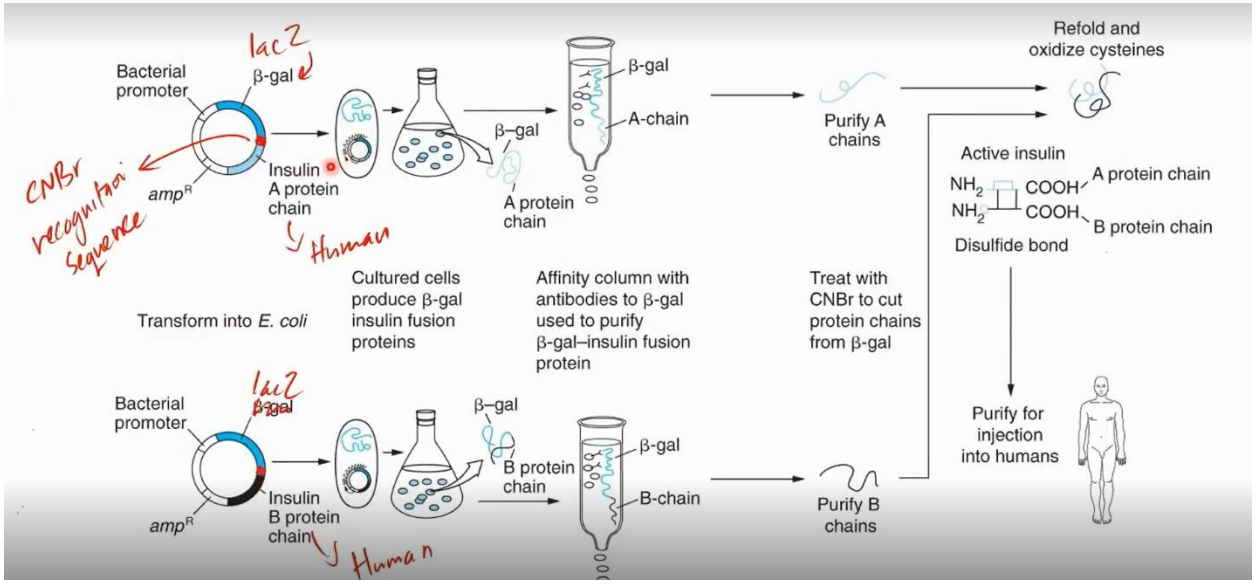


The proinsulin that results from the removal of the signal peptide will be in inactive form to convert it to active form the peptide c must be removed

The two peptide A,B are require for the activation of the insulin

So, the activation of insulin requires something called proteolysis (proteolytic cleavage) which is the removal of some amino acids or some regions of the protein

Before the recombinant DNA technology scientists extract the protein from animal and used to treat diabetes this could lead to bad immunological reactions or side effects



After the discovery of recombinant DNA technology the scientist cloned peptide A and peptide B in two different plasmid in two different E.coli

The A,B will be expressed in bacteria as a fusion proteins because of the fusion with the B-galactosidase (lacz gene)

The B-galactosidase always fused to the A,B peptide to make sure that the production goes smoothly and the protein doesn't unfold

or form inclusion bodies that because we are expressing a human gene inside a bacterial cell (make the purification easier)

Then the affinity column that contains antibodies that could capture B-galactosidase that are fused to the A,B chain this can extract the fusion protein, once the fusion protein are extracted from bacteria using affinity column chromatography chain A and chain B will be separated from the B-galactosidase using CNBR

between the lacz and A chain coding sequence we add CNBR recognition site and the same thing in B coding sequence

now the addition of CNBR will happen after the purification

and after that the A,B purified peptide will be mixed together and oxidized(to form disulfide bond) and by that we can get the final product of insulin and then the insulin can be ready to be used

remember in the 1982 the first insulin was produced by a company called genentic, in first the peptide A,B was chemical synthesized in the lab

most of the insulin that are found in the market are modified which mean some amino acids might be removed to increase the property of the insulin

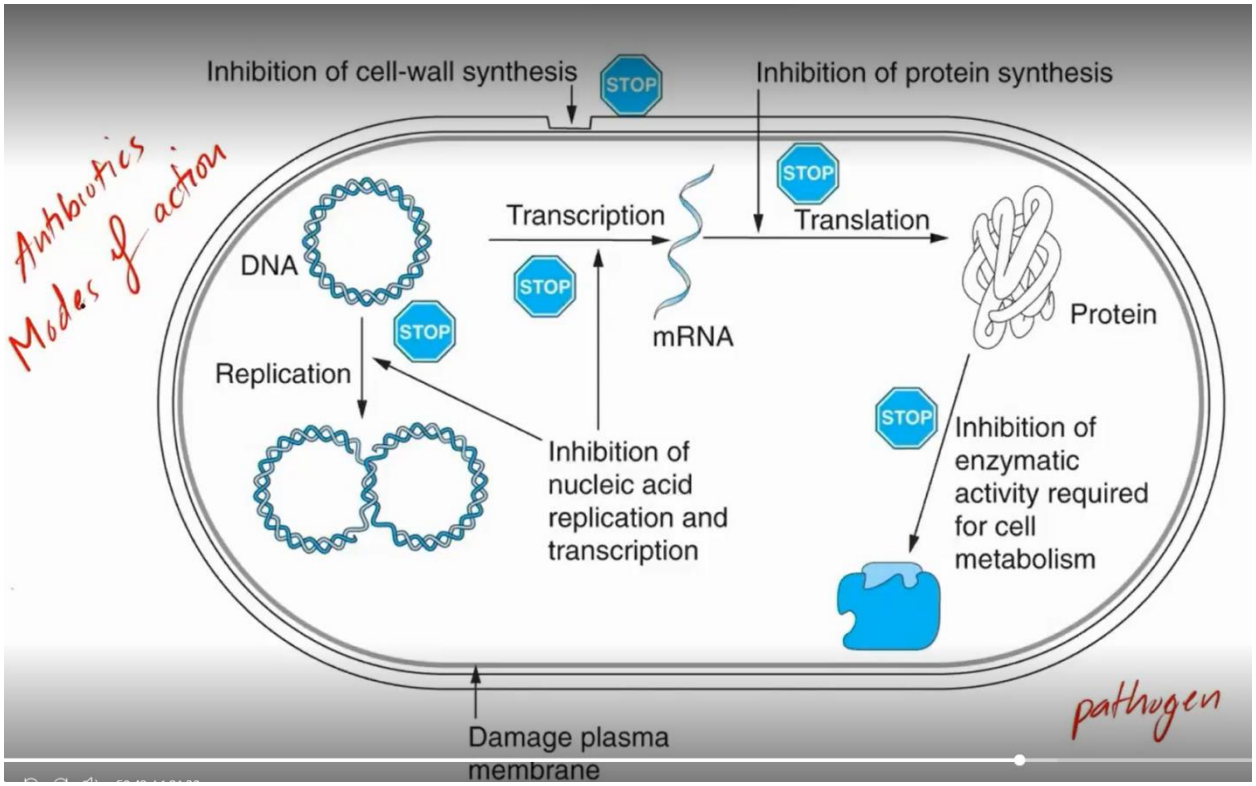
TABLE 5.1 THERAPEUTIC PROTEINS FROM RECOMBINANT BACTERIA

Protein	Function	Medical Application(s)
DNase	DNA-digesting enzyme	Treatment of patients with cystic fibrosis.
Erythropoietin	Stimulates production of red blood cells	Used to treat patients with anemia (low number of red blood cells).
Factor VIII	Blood clotting factor	Used to treat certain types of hemophilia (bleeding diseases due to deficiencies in blood clotting factors).
Granulocyte colony-stimulating factor	Stimulates growth of white blood cells	Used to increase production of certain types of white blood cells; stimulate blood cell production following bone marrow transplants.
Growth hormone (human, bovine, porcine	Hormone stimulates bone and muscle tissue growth	In humans, used to treat individuals with dwarfism. Improves weight gain in pigs and cows; stimulates milk production in cows.
Insulin	Hormone required for glucose uptake by body cells	Used to control blood sugar levels in patients with diabetes.
Interferons and interleukins	Growth factors that stimulate blood cell growth and production	Used to treat blood cell cancers such as leukemia; improve platelet counts; some used to treat different cancers.
Superoxide dismutase	An antioxidant that binds and destroys harmful free radicals	Minimizes tissue damage during and after a heart attack.
Tissue plasminogen activator (tPA)	Dissolves blood clots	Used to treat patients after heart attack and stroke.
Vaccines (e.g., hepatitis B vaccine)	Stimulate the immune system to prevent bacterial and viral infections	Used to immunize humans and animals against a variety of pathogens; also used in some cancer tumor treatments.

- **Antibiotics**
- Produced by microbes that inhibit the growth of other microbes
- 1928 discovery of penicillin by Alexander Fleming(the first antibiotic by chance)
- Majority are produced by bacteria, and inhibit the growth of other bacteria

They are not protein some are peptide the majority of anti-biotics are chemical compound that are used to kill bacteria or to treat infection disease caused by bacteria

Naturally they are produced by bacteria or Fungai to kill other bacteria or fungi, in nature microbes produce anti-biotics because they compete with other microbes on food



The majority of antibiotics can inhibit the growth of bacteria by targeting key process inside the bacteria

Some antibiotics inhibit the cell wall synthesis if this happen the bacteria will be killed easily

Most of the bacteria are good, but some of them are bad and called pathogens, if the pathogens enter our bodies the immune system can kill them but sometimes the number of pathogens that enter are overwhelming to immune system so we use the antibiotic to weaken the bacteria to help the immune system, or

sometimes the antibiotic are used to slow the growth of bacteria so that more time for the immune system will be provided to deal with the pathogens

Sometime the antibiotic will inhibit the translation process so the bacteria can't produce its protein which means they can't divide, can't increase their number

Some antibiotic target enzymes that are require for metabolism

Some inhibit the DNA replication

Improper use of antibiotics leads to bacteria becoming resistant to antibiotics → no longer gets affected by them.

Scientists are trying to discover new anti-microbe drugs.

Microbiologists try to find new bacteria that could produce new anti-biotic that could be used to kill anti-biotic resistant bacteria.

Superbugs: bacteria that is resistance to majority/ all of antibiotics used for treatments. Till now, no drug is available for them.

We can use bacteriophages to kill superbugs. Bacteriophage cocktail: mixture of different types of phages used to kill superbugs.

How does bacteria become resistance?

- When it has acquired foreign genes by transformation, conjugation or transduction, these genes could have antibiotic resistance genes.
- Bacteria can also undergo mutations that makes them resistance to certain antibiotics.

- Not finishing the full antibiotic course that the doctor prescribed, the bacteria might become resistant to it and therefore the antibiotic Is useless.
- Some foods we eat might contain some antibiotics in small quantities that are enough to make bacteria resistant to them.

Doctors might prescribe different antibiotics for the same bacteria; because there are different types of antibiotics that treat the same type of bacteria.

vaccines

Edward Jenner was the first to create vaccines, he isolated cowpox bacteria from cows and injected it to humans to protect against smallpox; small pox viruses that attach human cells are similar to the cowpox viruses.

How do vaccines work?

They stimulate the immune system to produce antibodies against viruses and bacteria and fungi, just like the antibodies that your body naturally stimulates against pathogens.

Vaccine has to be taken before catching the disease.

Three Major Strategies to Make Vaccines

1. Subunit vaccines are made by injecting portions of viral or bacterial structures

2. Attenuated vaccines use live bacteria or viruses that have been weakened through aging or by altering their growth conditions to prevent replication

3. Inactivated (killed) vaccines are made by killing the pathogen and using the dead or inactivated microorganism for the vaccine.

Vaccines can be categorized into one of several groups:

1. Live attenuated bacteria
   • (bacillus Calmette– Guèrin, BCG, used to immunize against tuberculosis)
2. Dead or inac4vated bacteria
   • (e.g. cholera and pertussis vaccines)
3. Live attenuated viruses
   • (e.g. measles, mumps and yellow fever viral vaccines)
4. Inactivated viruses
   • (e.g. hepatitis A and polio (Salk) viral vaccines)
5. Toxoids
   • (e.g. diphtheria and tetanus vaccines)
6. Pathogen-derived an4gens
   • (e.g. hepatitis B, meningococcal, pneumococcal and Haemophilus influenzae vaccines)
7. Nucleic acid vaccines

Types of Vaccines

Vaccine Type	What is it?	Challenges	Examples
Live Attenuated	Weakened version of living microbe that can't cause disease	Mutation; Storage	Measles, mumps, rubella, polio (Sabin vaccine), yellow fever
Inactivated or "killed"	Microbes killed with chemicals, heat or radiation	Weaker immune response; Need boosters	Cholera, flu, hepatitis A, Japanese encephalitis, plague, polio (Salk vaccine), rabies
Subunit	Include antigens (or epitopes) that best stimulate immune system	Identifying specific antigen takes time	Hepatitis B, pertussis, pneumonia caused by S. Pneumoniae
Toxoid	Formalin inactivated toxins used as vaccine	Used when main cause of illness is a bacterial toxin	Diphtheria, Tetanus
Conjugate	Specialized subunit vaccine where antigens are linked to polysaccharides	Most effective for immature immune system of infants	H. Influenzae type b, pneumonia caused by S. Pneumoniae
DNA	DNA of important Antigens introduced to cell	Experimental	influenza and herpes as well as HIV
Recombinant vector	attenuated virus or bacterium (vector) used to introduce microbial DNA to cells	Experimental	HIV, rabies, and measles

• (e.g. COVID-19)This table list the different types of vaccine, what they are used for, and their advantages, disadvantages and some examples for each vaccine

- Live attenuated is where the pathogens whether it was virus or bacteria are not killed, they are weaken and injected to protect our immune system from future infection with same virus or bacteria

Now the problem of this vaccine is that they had to be stored at certain temperature, also mutation can happen to them, so they cause disease as a result for the mutation

Attenuation (the weaken) of viruses and bacteria can be done by several method genetic and non-genetic method

So, some viruses may require the removal of certain gene for the virus to become weaker and doesn't cause disease for us

- The inactivated or killed from its name it involves the killing of viruses or bacteria and injected into the body

Now the problem with this vaccine that they don't stimulate the immune response as the live attenuated vaccine, so that why we need boosters more than one inject

But the advantages are that they are safer also it doesn't require the storage in a very low temperature

- Subunit vaccine they are just protein from viruses and bacterial infection so the body can recognize them

- Toxoid vaccine these are the toxins secreted by bacteria that can be inactivated by formalin (chemical) and injected as a vaccine so when you get bacterial toxin by food for example the vaccine can help the immune system to protect itself from them

So, for example diphtheria is caused by bacteria called Corynebacterium diphtheriae, another disease caused by bacterial toxin is tetanus Clostridium tetani

- Conjugate vaccine here the antigens or protein will be linked with polysaccharides, these polysaccharides will be found on the surface of certain type bacteria like

haemophilus influenzae and streptococcus pneumonia that cause pneumonia in kids

- DNA vaccine they used to be experimental but now they are used for covid 19

- Recombinant vector vaccine which is basically putting the DNA inside virus or bacterial vector, so the virus or bacteria will introduce the dan to the cell these also used in some of the covid vaccine

• Currently, a majority of subunit vaccines are made using recombinant DNA approaches in which the vaccine is produced in microbes

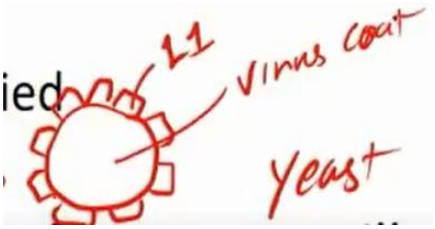
• Hepatitis B (protect against hepatitis B virus)
• Genes for proteins on the outer surface of the virus are cloned into expression plasmids and transformed into yeast
• Fusion proteins produced by the yeast are purified (to be used as a vaccine)

• Gardasil, which protects against four strains of human papillomavirus (HPV)

This a vaccine against cancer that is caused by human papillomavirus, this virus can infect both males and females but in female it causes cervical cancer

In western country girls and women from age 9-45 have to take this vaccine because human papillomavirus infections which are sexually transmitted are very common in the western country
Also, male can take this vaccine because this virus cause some disease in males as well

Now again this vaccine is a subunit vaccine so there is a recombinant surface protein of this virus, and this recombinant protein will assemble just like a virus but without having the virus genetic material so it called virus-like particle, which means this vaccine contain a virus but it's an empty virus so it have the same structure as the (HPV) but without the genetic material of the virus, so there will be the virus structure and the surface protein that will stimulate the immune system



Gardasil is also produced inside the yeast

Microbial Genomes

Sequencing microbial genome can be done easily because they are smaller than eukaryotic genome

• Identify genes involved in bacterial cell metabolism, cell division, and genes that cause human and animal illnesses

The process of sequencing is to identify new genes maybe these new genes produce new enzyme that could be used in biotechnology applications, or maybe to understand more about bacteria that will cause human and animal illnesses

• Find new strains

  • For bioremediation or other tasks

  • Disease causing organisms

2008 NIH announced plans for the Human Microbiome Project

  • Five year project to sequence 600 genomes of microorganisms that live on and inside humans

Microbiota & Microbiome

Microbiota represent the organism that are found inside our body

The science look to the human body as human cells and microbial cells, we have microbial cells inside our body more

than human cells this why scientist consider that human having two genomes, human genome, and microbial genome

The organism we have in our body consist of bacteria, viruses, archaea, fungi now all of these will be carrying their own gene and genome

So, the microbiota is the non-human cell found in our body and they will be found in the respiratory system, intestinal system, vagina, oral, skin

Now these organisms they interact with our cells and their present is affected by the type of food we eat by our genes, by some environmental conditions, and the drugs we take

Scientist have linked the microbiome and microbiota with many disease types

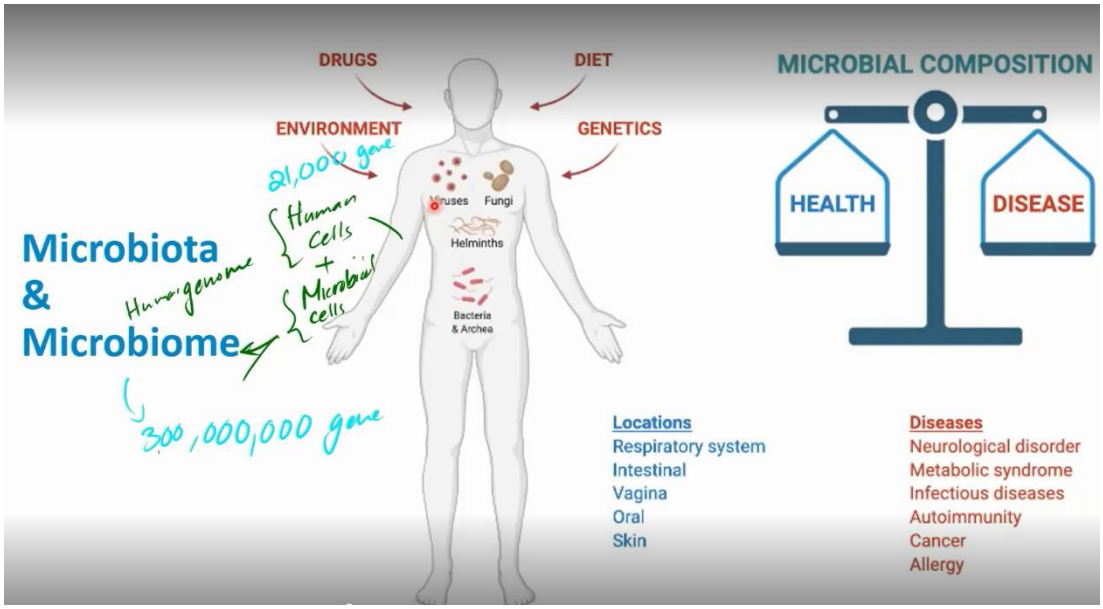
So, the scientist that the microbial composition in our body might affect the balance between health and disease, so some diseases like neurological disorder, metabolic syndrome, infectious disease, autoimmunity, cancer, allergy are caused by the unbalance caused by the changing of microbial composition, or by distribution in microbiota or microbime

Now the advantages of microbiome is that they help us to digest our food, they synthesis some vitamin and other important molecules, they protect us against pathogenic organism, sometime if you take a lot of anti-biotic you might kill microbiota especially the good bacteria

Now these bacteria that are found in our body they can affect the gene expression so there is an interaction, communication between the microbiota and the human cell

Sometimes when you take a drug and it reach the intestine for example the bacteria or microbiota may destroy the drug so you will not get any benefit from the drug

Some scientists claimed that the microbiota have an affect in our emissions



Now in the human there will be 21,000 gene, but the microbiota will contain 300,000,000 different gene

•Goals of the Human Microbiome Project

• determine if individuals share a core human microbiome

• understand how we acquire and maintain microbial communities

• understand how changes in the microbiome can be correlated with changes in health, and conditions that affect the microbiome

• develop new methods for analysis of the microbiome

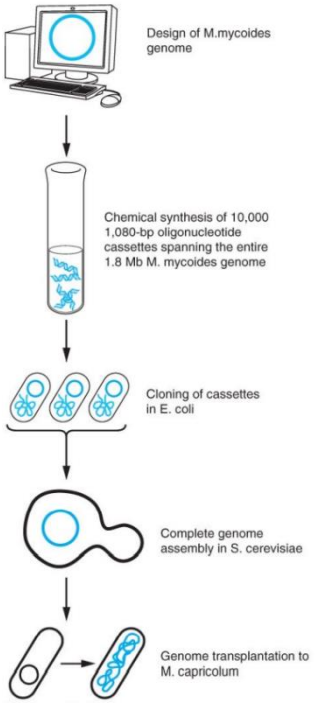
• address ethical, legal and social implications raised by human microbiome research

Microbial Genomes

• Creating Synthetic Genomes: A Functional Synthetic Genome Is Produced for a Bacterial Strain

• The creation of M. mycoides JCVI-syn 1.0 because, while it did not create life from an inanimate object, it is a "proof" of concept the synthetic genomes can be produced.

• It is speculated that new bacterial and other cells can be designed and programmed to be controlled as we want them to be for many uses.



Microbes for Making Biofuels

• Biorefineries could convert cellulose from stalks and other biomass into sugars that could be used to make ethanol sustainably.

Now we have the oil refineries which are big factory that produce diesel, gas, benzine ….. and this the traditional method to produce oil

But there is biorefineries that use microbes such as bacteria, fungi to convert cellulose from plants into sugars and these sugar could be used to make ethanol and this ethanol can be used as biofuel

• Microbes are being genetically engineered to more effectively break down cellulose to sugars, or converting sugars to ethanol.

So for example when we harvest the crops like corn crops the green part of plants that we don't use for food are called biomass, and these biomass are reach with cellulose so they can be used to make biofuel

• Bioprospecting efforts seek to identify microbes which produced other enzymes useful for making biofuels.

Good luck <3

Team alpha

Sarah qandeel

Mohammad riyad

Mohammad qandeel

Kareen mohammad