UNIT 3C - PAPER 2

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VERSION : 2.00

LAST UPDATED : 01-03-2025

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UNIT 3C - PAPER 2
FERMENTATION TECHNOLOGY

1. Microbes
2. Microbial Processes.

UNIT - 3C1 | PAPER - 2

MICROBES

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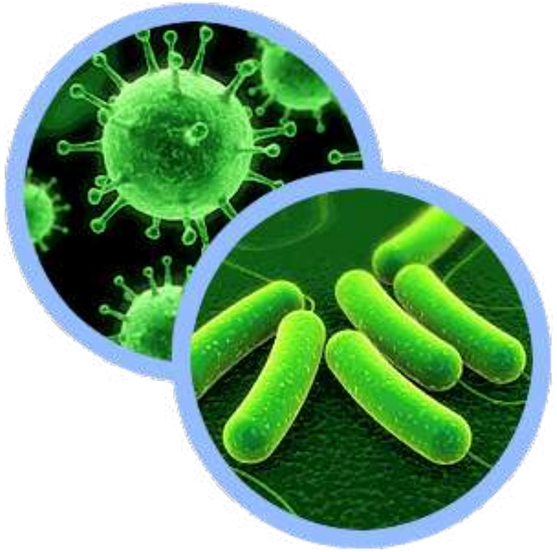
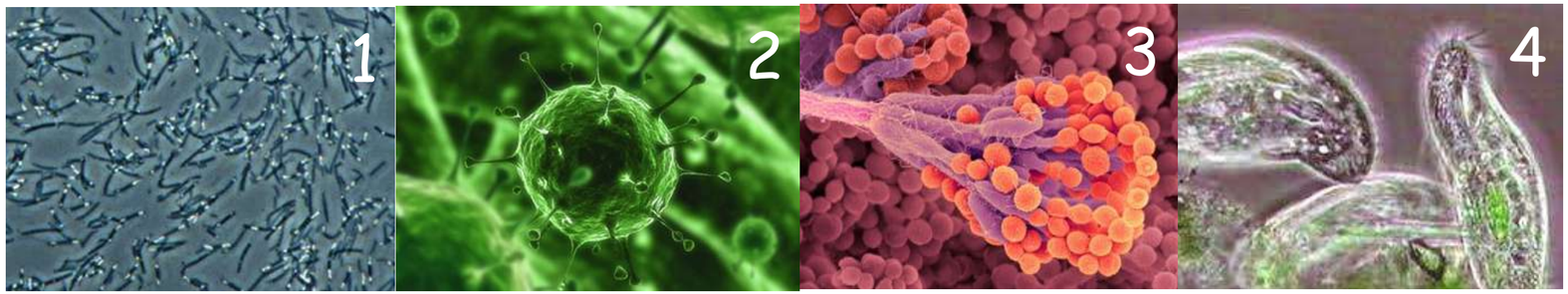
WHAT ARE MICROBES?

Microbes are tiny organisms—too tiny to see without a microscope, yet they are abundant on Earth. They live everywhere—in air, soil, rock, and water. Some live happily in searing heat, while others thrive in freezing cold. Some microbes need oxygen to live, but others do not. These microscopic organisms are found in plants and animals as well as in the human body.

Some microbes cause disease in humans, plants, and animals. Others are essential for a healthy life, and we could not exist without them. Indeed, the relationship between microbes and humans is delicate and complex. Some microbes keep us healthy while others can make us sick.

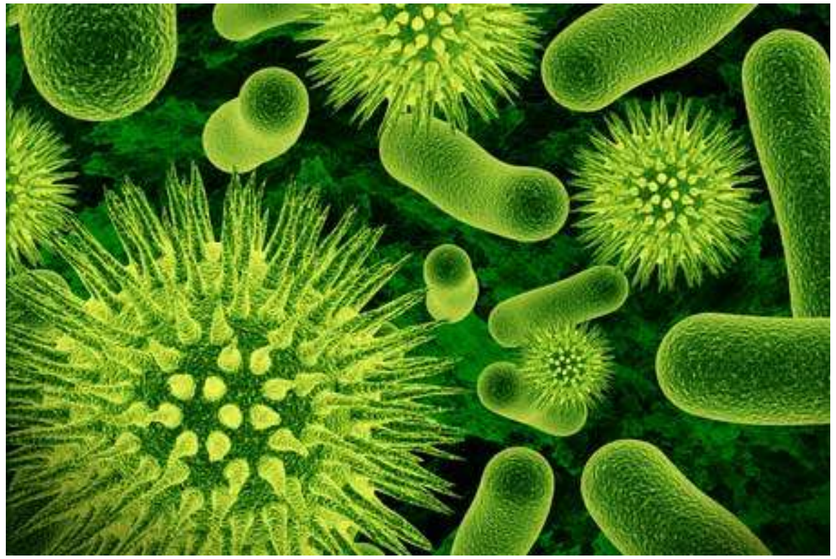




Most microbes belong to one of four major groups:

1. bacteria
2. viruses
3. fungi
4. protozoa.

A common word for microbes that cause disease is “germs.” Some people refer to disease-causing microbes as “bugs.” “I’ve got the flu bug,” for example, is a phrase you may hear during the wintertime to describe an influenza virus infection.



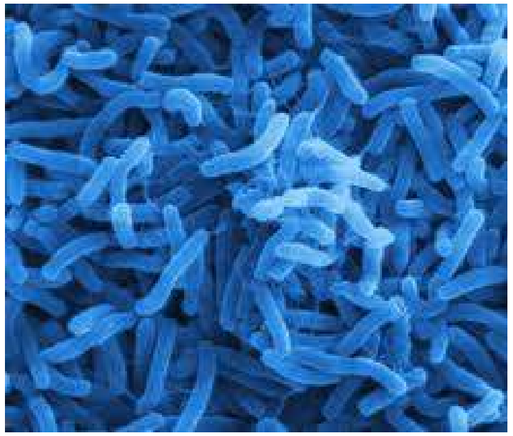
Since the 19th century, we have known that microbes cause infectious diseases. Near the end of the 20th century, researchers began to learn that microbes also contribute to many chronic diseases and illnesses. Mounting scientific evidence strongly links microbes to some forms of cancer, coronary artery disease, diabetes, multiple sclerosis, and chronic lung diseases.

BACTERIA

Microbes belonging to the bacteria group are made up of only one **cell**. Under a microscope, bacteria look like balls, rods, or spirals. The shape of a bacterial cell helps scientists identify the type of bacteria. Bacteria are so small that a line of 1,000 could fit across the eraser of a pencil.

Borreliaburgdorferi

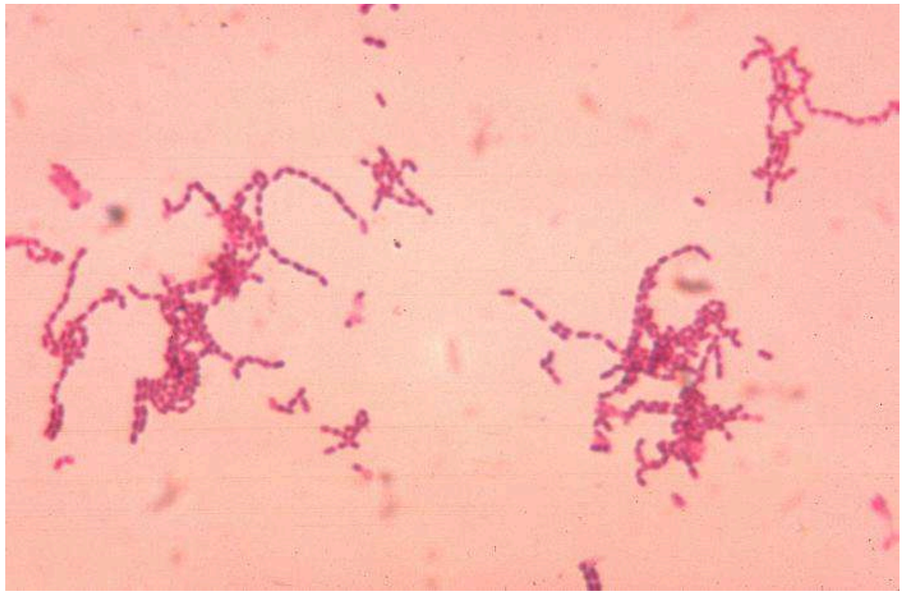
Filamentous cyanobacterium

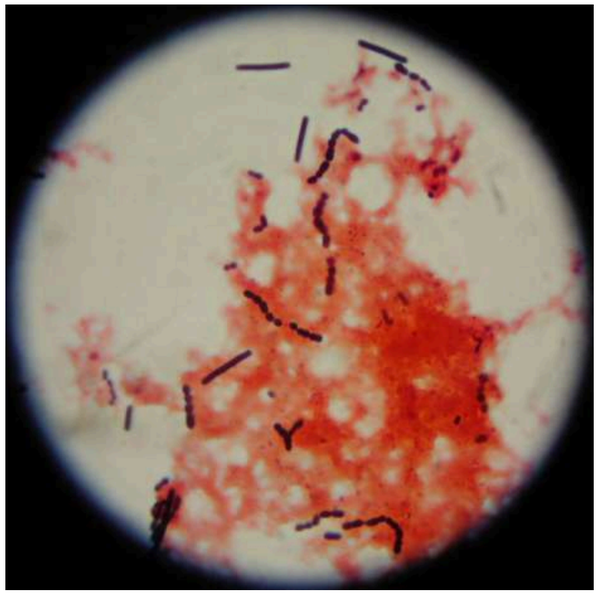


Cholera

Some bacteria (aerobic bacteria) need oxygen to survive. Others (anaerobic bacteria) do not. Amazingly, some can adapt to new environments by learning to survive with or without oxygen. Like all living cells, each bacterium requires food for energy and building materials. There are countless numbers of bacteria on Earth—most are harmless, and many are even beneficial to humans.

Less than 1 percent of bacteria cause diseases in humans. For example, harmless anaerobic bacteria, such as Lactobacilli acidophilus, live in our intestines, where they help digest food, destroy disease-causing microbes, fight cancer cells, and give the body needed vitamins. Healthy food products, such as yogurt, sauerkraut, and cheese, are made using bacteria.

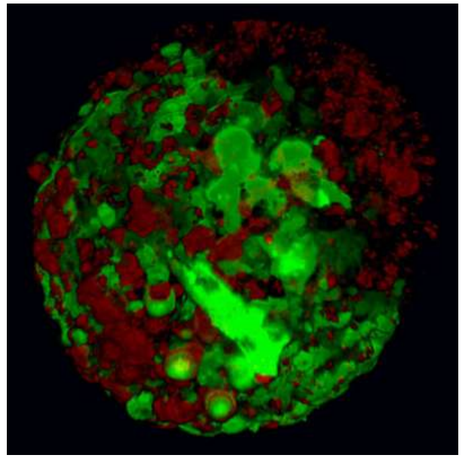




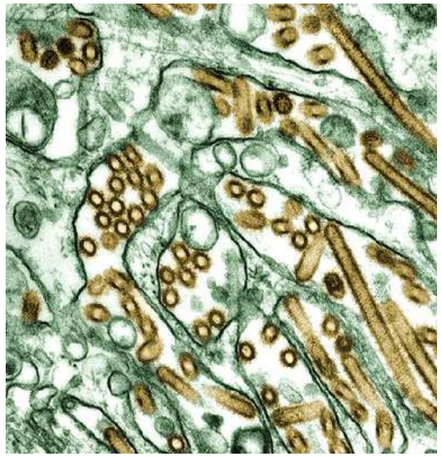
Some bacteria, however, produce poisons called toxins, which can make us sick. For example, botulism, a severe form of food poisoning, affects the nerves and is caused by toxins from Clostridium botulinum bacteria.

VIRUSES

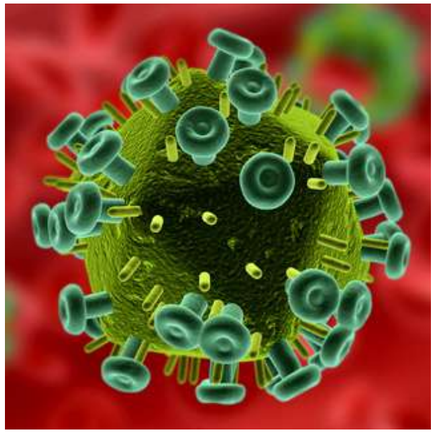
Viruses are among the smallest microbes, much smaller even than bacteria. Viruses, however, are not cells. They consist of one or more molecules of DNA or RNA, which contain the virus' genes surrounded by a protein coat. Viruses can be rod-shaped, sphere-shaped, or multisided. Some viruses look like tadpoles.



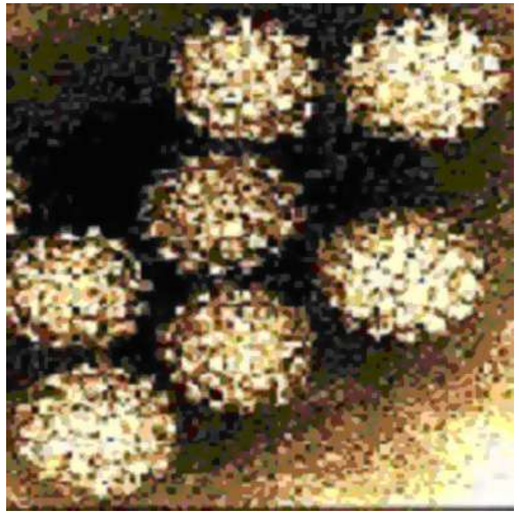
Cancer



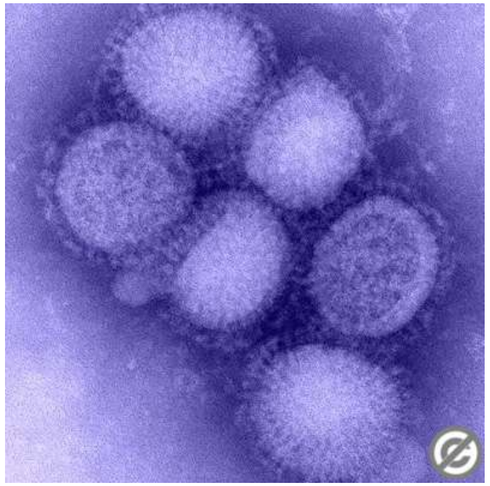
H5N1 Avian flu



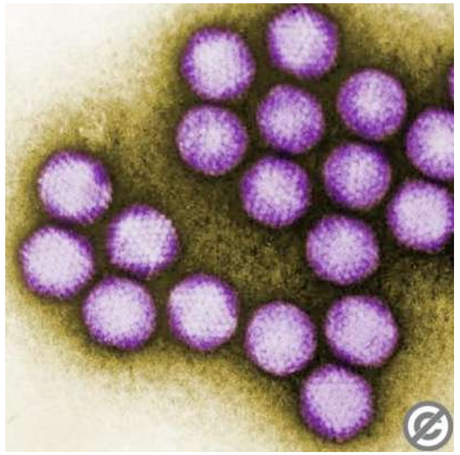
Unlike most bacteria, most viruses do cause disease because they invade living, normal cells, such as those in your body. Once inside the cells, they multiply and produce other viruses like themselves. Each virus is very particular about which cell it attacks. Various human viruses specifically attack particular cells in your body's organs, systems, or tissues, such as the liver, respiratory system, or blood.



Warts



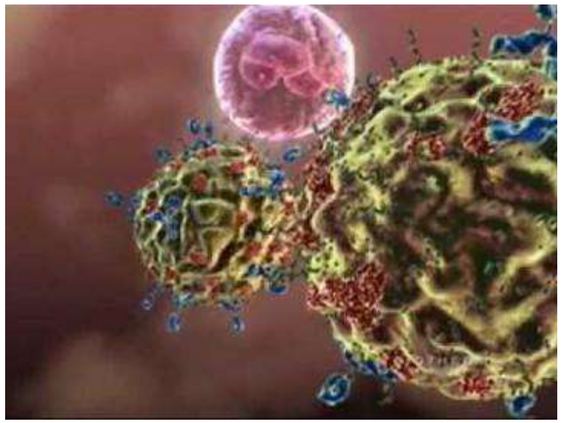
HiNi Swine Flu



Adenovirus

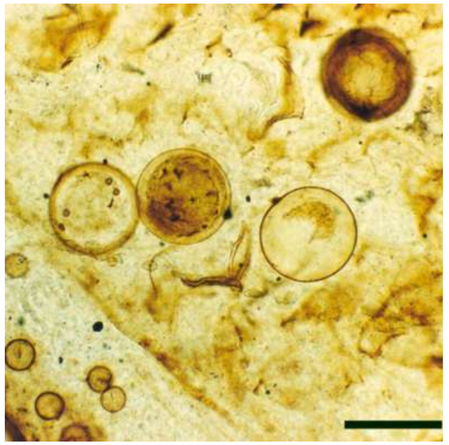
Although types of viruses behave differently, most survive by taking over the machinery that makes a cell work. When a virus comes in contact with a cell it likes, it attaches to the surface of that cell. From there, the virus may inject molecules into the cell, or the cell may swallow part of the virus.

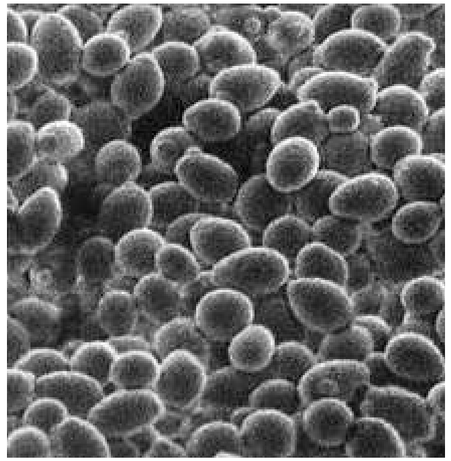
Once inside the cell, viral molecules such as DNA or RNA take over the cell's functions and direct the cell to make new virus offspring. That's how a virus infects a cell.



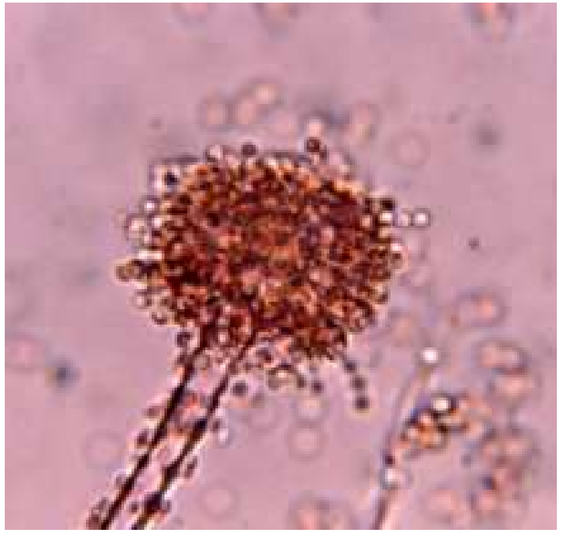
FUNGI

A fungus is actually a primitive plant. Fungi can be found in air, in soil, on plants, and in water. Thousands, perhaps millions, of different types of fungi exist on Earth. The most familiar ones to us are mushrooms, yeast, mold, and mildew. Some live in the human body, usually without causing illness.

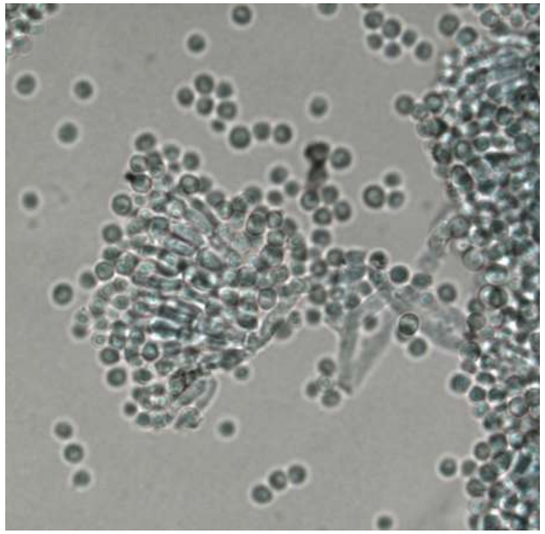




Fungal diseases are called mycoses. Mycoses can affect your skin, nails, body hair, internal organs such as your lungs, and body systems such as your nervous system. Aspergillus fumigatus fungi, for example, can cause aspergillosis, a lung disease. Some fungi have made our lives easier. Penicillin and other antibiotics, which can kill harmful bacteria in our bodies, are made from fungi.



ASPERGILLOSIS

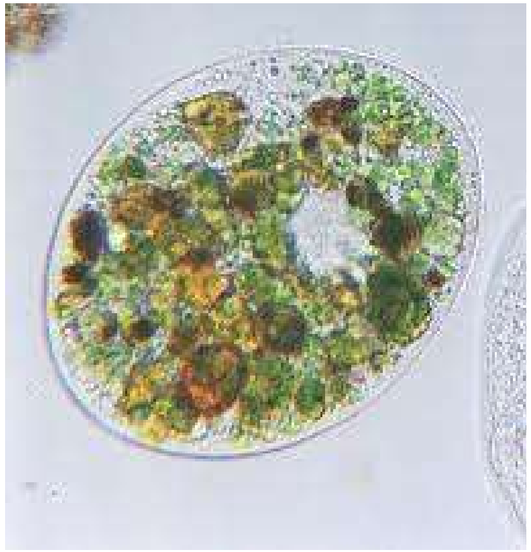


PENICILLIUM

Other fungi, such as certain yeasts, also can be helpful. For example, when a warm liquid, such as water, and a food source, such as sugar, are added to certain yeasts, the fungus ferments. The process of fermentation is essential for making healthy foods like some breads and cheeses.

PROTOZOA

Protozoa are a group of microscopic one-celled animals. Protozoa can be parasites or predators. In humans, protozoa usually cause disease.

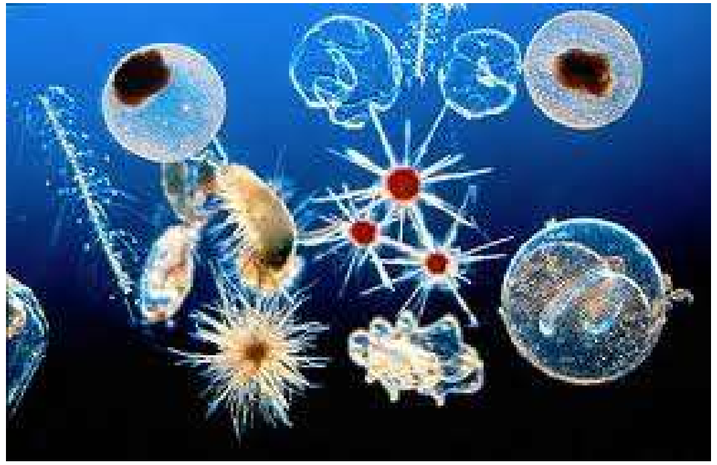


AMOEBA

GIARDIA

PROTOZOA

Some protozoa, like plankton, live in water environments and serve as food for marine animals, such as some kinds of whales. Protozoa also can be found on land in decaying matter and in soil, but they must have a moist environment to survive.



MARINE PLANKTON

PROTOZOA IN SOIL

UNIT - 3C2 | PAPER - 2

FERMENTATION TECHNOLOGY

INTRODUCTION

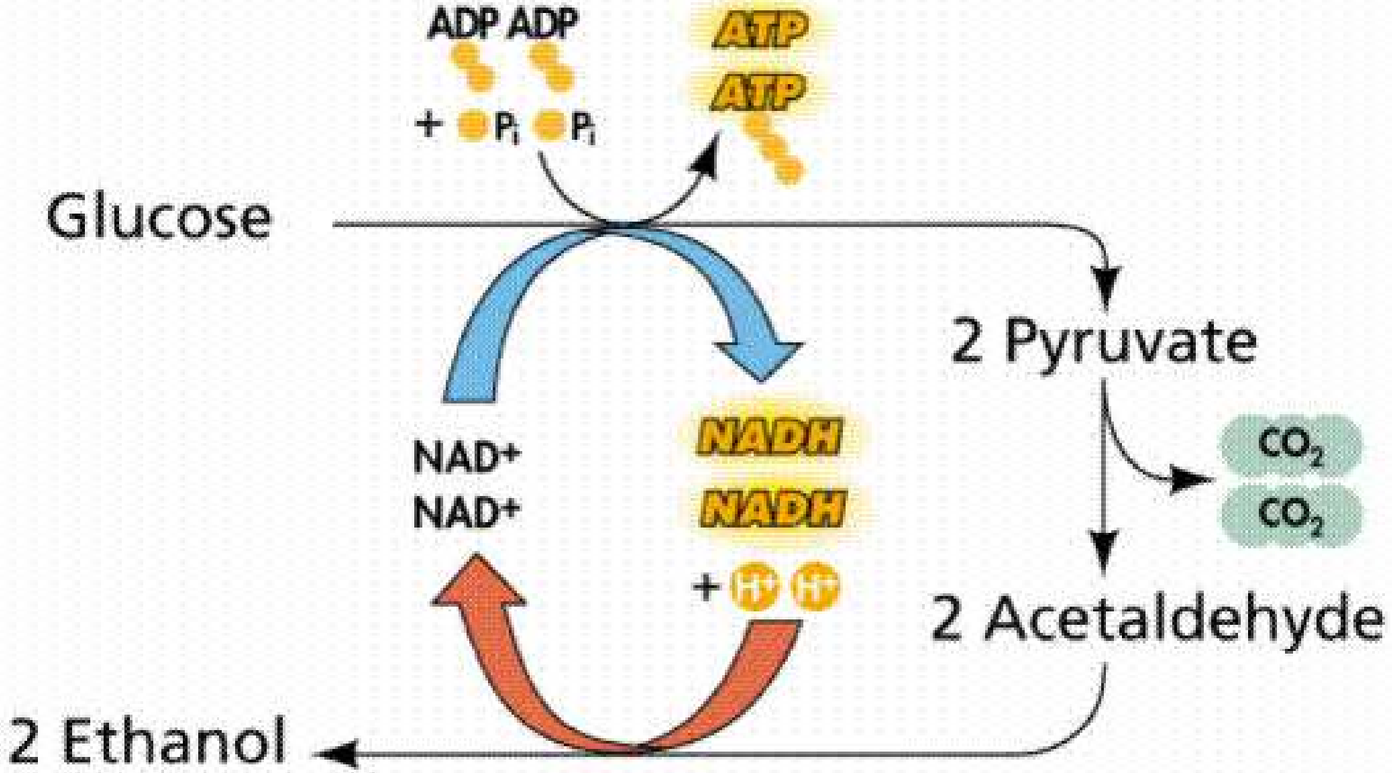
- FERMENTATION TECHNOLOGY

  microorganisms, grown on a large scale, to produce valuable commercial products or to carry out important chemical transformations.

- FERMENTATION

Pasteur's "life without air",

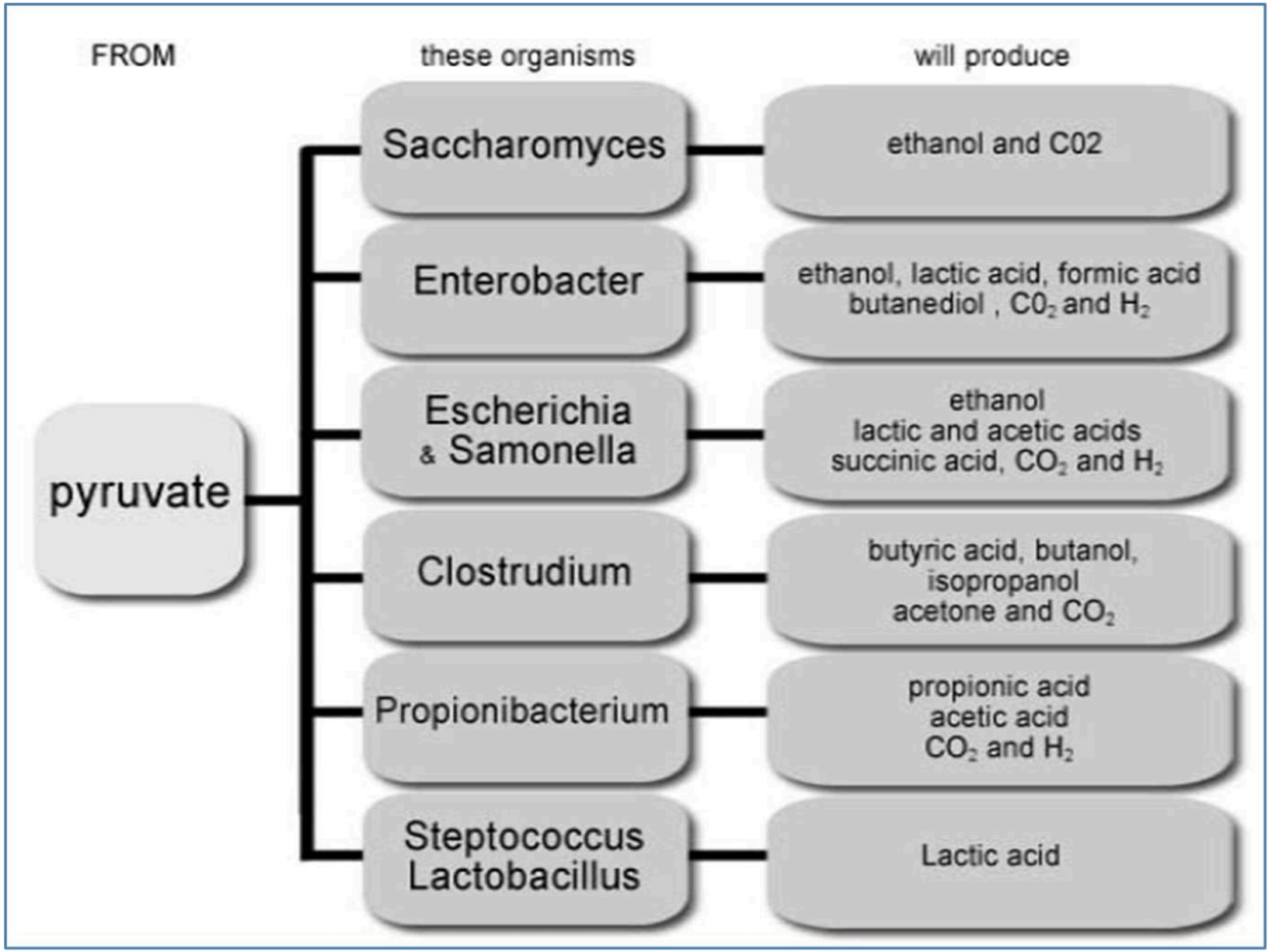
Latin word fervere, to boil



Eduard Buchner 1897

Fermented no living yeast cells in the mixture

1907, Nobel Prize in Chemistry



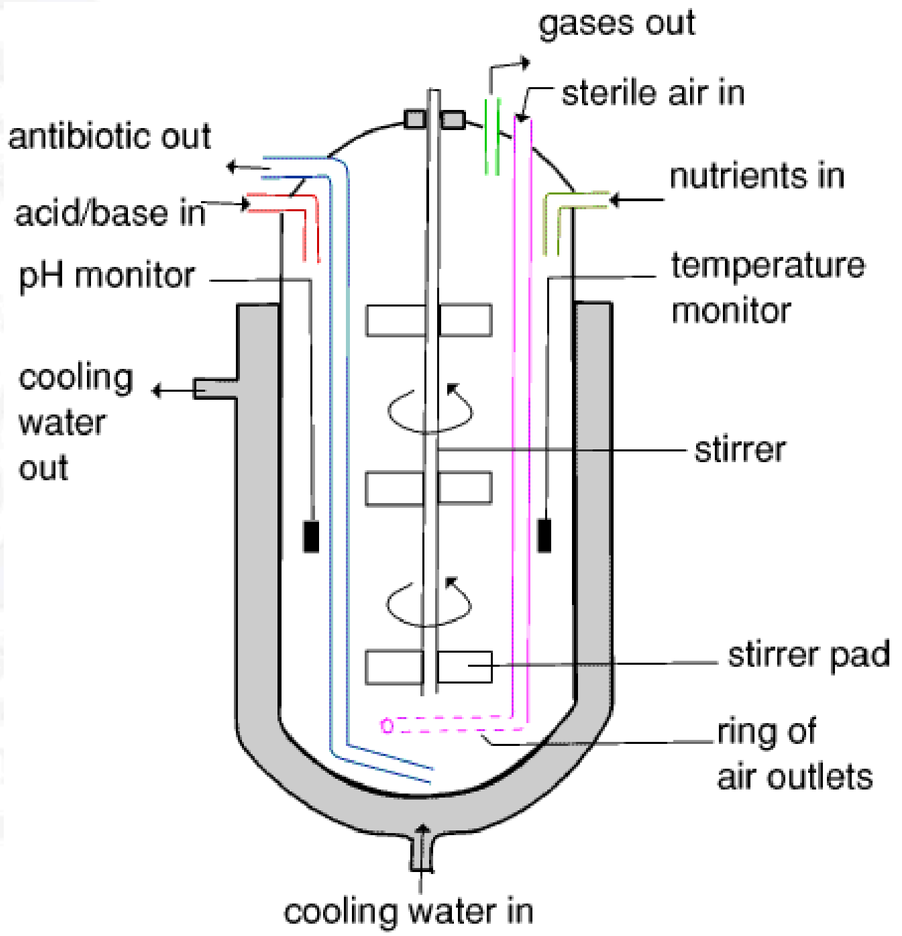
SOME IMPORTANT FERMENTATION PRODUCTS

Product	Organism	Use
Ethanol	Saccharomyces cerevisiae	Industrial solvents, beverages
Glycerol	Saccharomyces cerevisiae	Production of explosives
Lactic acid	Lactobacillus bulgaricus	Food and pharmaceutical
Acetone and butanol	Clostridium acetobutylicum	Solvents
-amylase	Bacillus subtilis	Starch hydrolysis

INDUSTRIAL SCALE

Fermentor is the basic equipment used for fermentation.

- contains the media to carry out fermentation, and creates environment for fermentation at large scale.



REQUIREMENTS

- **Pure culture:** organism, quantity, physiological state
- **Sterilised medium:** for microorganism growth
- **Seed fermenter:** inoculum to initiate process
- **Production fermenter:** large model
- **Equipment** -

1. drawing the culture medium
2. cell separation
3. collection of cell
4. product purification
5. effluent treatment.

FERMENTATION TECHNIQUES

SURFACE (SOLID STATE)

- microorganisms cultivated on the surface of a liquid or solid substrate.
- complicated and rarely used in industry.
- Mushroom, bread, cocoa, tempeh

SUBMERSION TECHNIQUES

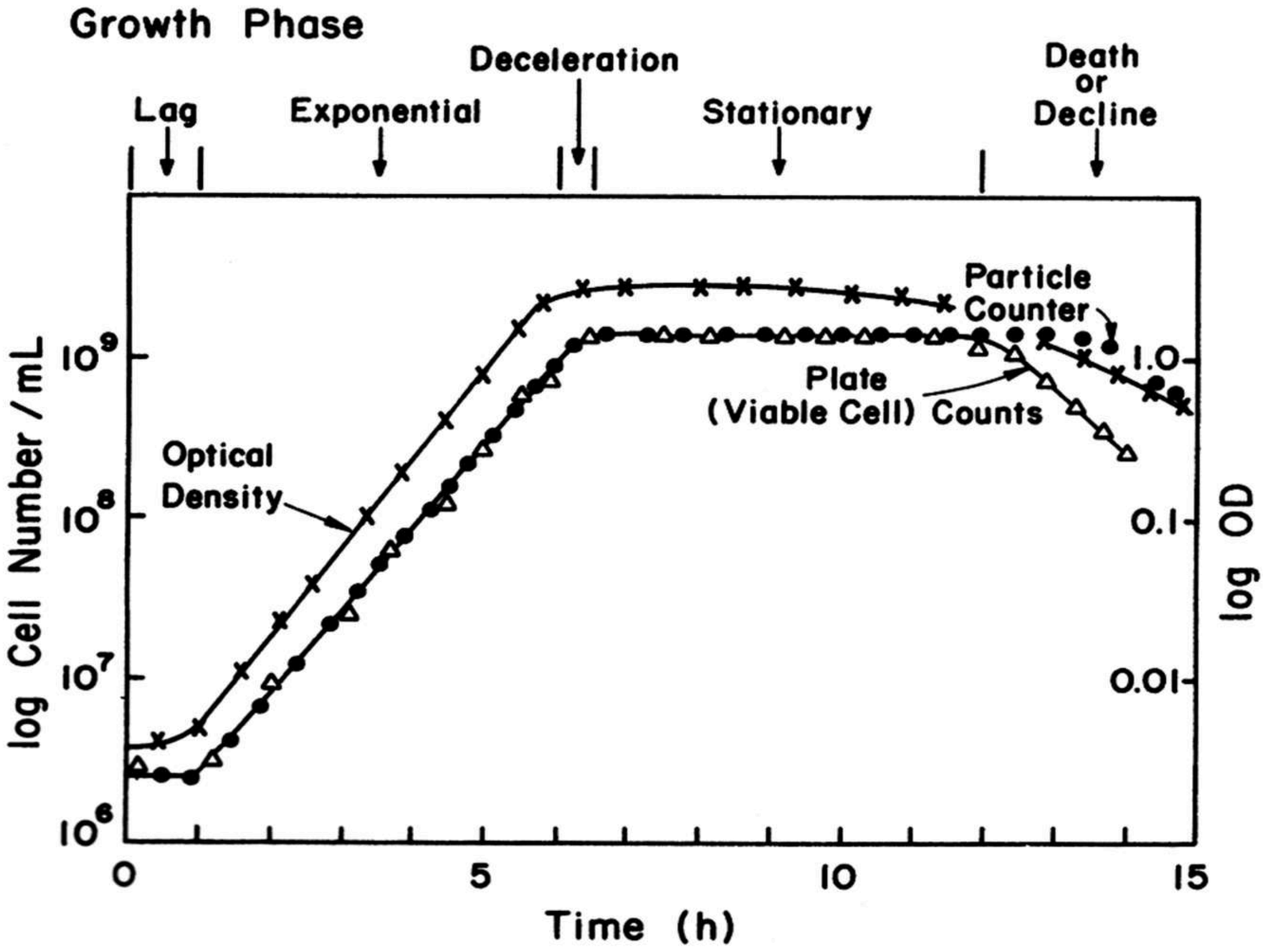
- microorganisms grow in a liquid medium.
- (biomass, protein, antibiotics, enzymes and sewage treatment) are carried out by submersion processes.

TYPES ON THE BASIS OF CULTURE

BATCH FERMENTATION

Sterile nutrient substrate , inoculated, grow until no more of the product is being made, "harvested" and cleaned out for another run.

- lag phase (adapt to their surroundings)
- exponential growth (grow in numbers)
- stationary phase (stop growing)
- death phase



CONTINUOUS FERMENTATION

- Substrate is added continuously to the fermenter, and biomass or products are continuously removed at the same rate.
- Under these conditions the cells remain in the logarithmic phase of growth

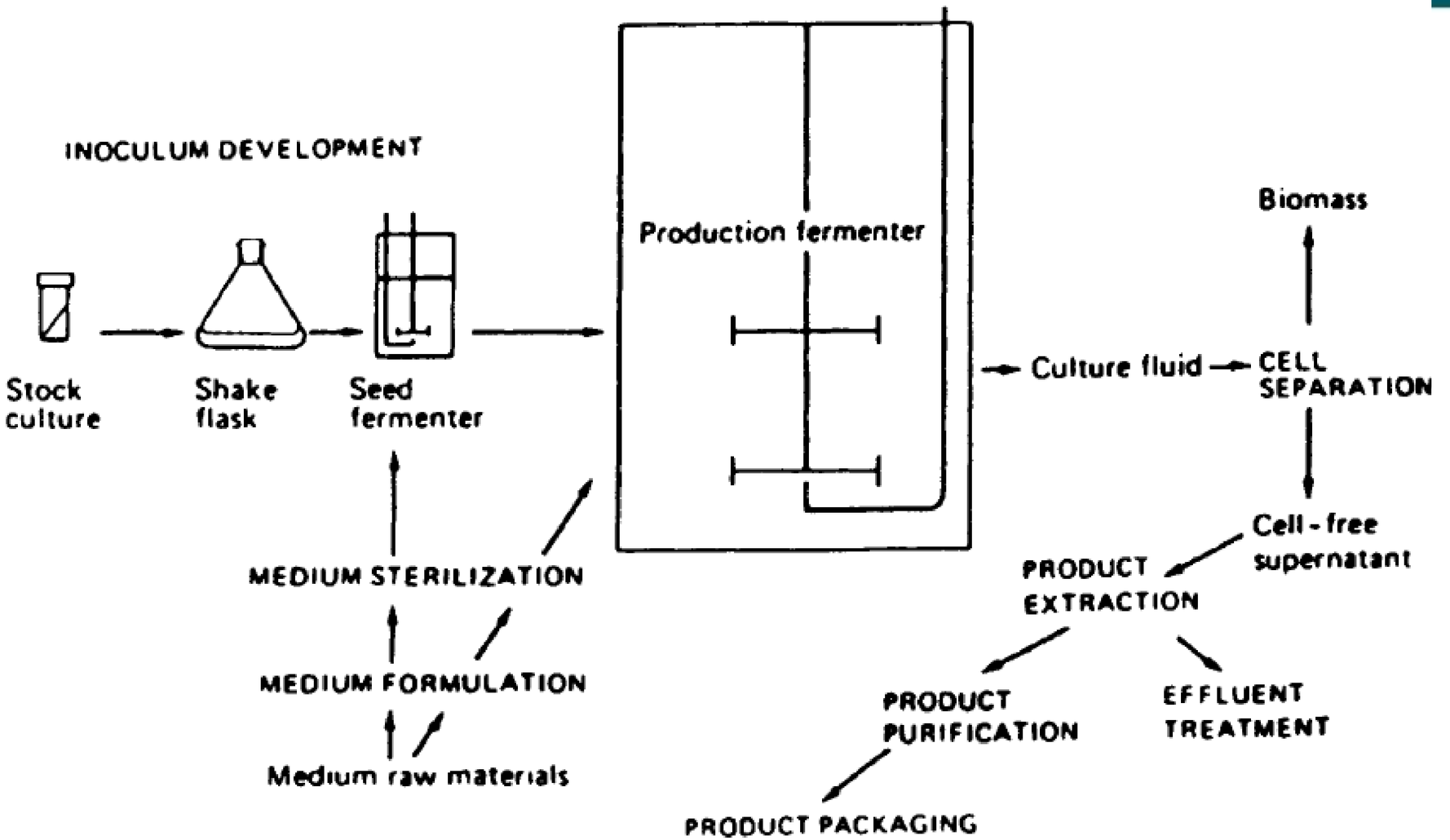
RANGE OF FERMENTATION TECHNOLOGY

• Microbial cell (Biomass)	Yeast
• Microbial enzymes	Glucose isomerase
• Microbial metabolites	Penicillin
• Food products	Cheese, yoghurt, vinegar
• Vitamins	B12, riboflavin

Table 1
Examples of foods and food additives manufactured using industrial fermentation processes in developing countries[a]

Alcoholic beverages	Wines, beer
Milk and milk products	Cultured milks, yogurts, cheeses
Flavors	Monosodium glutamate, nucleotides
Organic acids	Lactic acid, citric acid, acetic acid
Amino acids	Lysine, glutamic acid
Vitamins	Vitamins A, C and B_{12}, riboflavin
Enzymes	Amylases, proteases, invertases

[a] From Deshpande and Salunkhe (2000).



A generalized, schematic representation of a fermentation process

- P.F. STANBURY, A. WHITAKER AND S. J. HALL, PRINCIPLES OF FERMENTATION TECHNOLOHY

ADVANTAGES

1. Preserves and enriches food, improves digestibility, and enhances the taste and flavour of foods.
2. Potential of enhancing food safety by controlling the growth and multiplication of a number of pathogens in foods.
3. Important contribution to human nutrition, particularly in developing countries, where economic problems pose a major barrier to ensuring food safety.
4. Low energy consumption due to the mild operating conditions relatively low capital and operating costs relatively simple technologies.
5. They cause highly specific and controlled changes to foods by using enzymes.
6. Preservation and detoxification of the food.
7. Waste treatment.
8. Health related product.

Table 41.7 Major Categories and Examples of Fermented Milk Products

Category	Typical Examples
I. Lactic fermentations	
Mesophilic	Buttermilk
	Cultured buttermilk
	Långofil
	Tëtmjolk
	Ymer
Thermophilic	Yogurt, laban, zabadi, labneh, skyr
	Bulgarian buttermilk
Therapeutic	Biogarde®, Bifighurt®
	Acidophilus milk, yakult
	Cultura-AB®
II. Yeast-lactic fermentations	Kefir, koumiss, acidophilus-yeast milk
III. Mold-lactic fermentations	Viili

Source: Table 3.1, p. 58. In B. A. Law, editor. 1997. *Microbiology and Biochemistry of cheese and fermented milk*, 2nd ed. New York: Chapman and Hall.

DISADVANTAGES

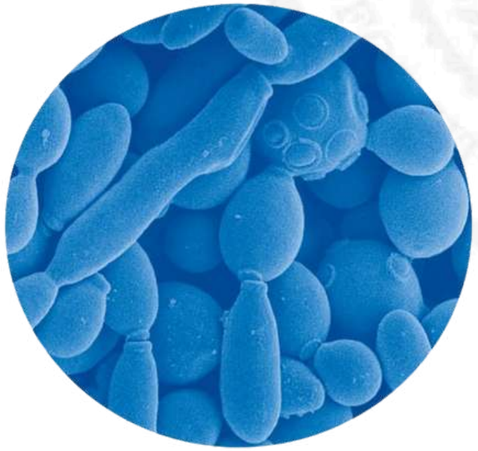
- Hazardous microbial contamination always exist in fermented food

- The uneven distribution of salt in lactic acid fermented fish products and contamination of Aspergillus flavus in traditional starter cultures for rice wine and soybean sauce result in severe food poisoning incidences

- Health(obesity, cancer)

Fermentation

- is a means to → Harvest Energy from Food
- is employed by
  - Simplest Single-Celled Organisms
    - include
      - Anaerobic Bacteria → act to turn → Garbage into Humus
      - Yeast → acts to turn → Grape Juice into Wine → creates → Ethanol (Alcohol) + CO_2
  - Advanced Cells as Back-up to Respiration → example → Strenuous Exercise Depletes Oxygen in Muscles Cells → leads to → Lactic Acid Byproduct → leads to → Soreness in Muscles
    - also found in → Yoghurt
- serves to → Burn Fuel in Absence of Oxygen → is called → An "Anaerobic" Process



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