Microbial growth
by
Dr. Nawres Norri

Bacterial Division

- ✓ Bacteria divide by **binary fission** where individual cells enlarge and divide toyield two progeny of approximately equal size . This don by Nuclear division precedes cell division .
- ✓ A few bacterial species reproduce by **budding;** they form a small initial outgrowth (a bud) that enlarges until its size approaches that of the parent cell, and then it separates.
- ✓ Some filamentous bacteria (certain actinomycetes) reproduce by producing chains of conidiospores carried externally at the tips of the filaments.
- ✓ A few filamentous species simply fragment, and the fragments initiate the growth of new cells..

Generation Time or Doubling Time

The size of a population of bacteria in a favorable growth medium increases exponentially. The interval of time between two cell divisions, or the time required for a bacterium to give rise to two daughter cells under optimum conditions, is known as the generation time or doubling time.

It varies considerably among organisms and with environmental conditions, such as temperature.

Most bacteria have a generation time of 1 to 3 hours and In coliform bacilli and many other medically important bacteria, it about 20 minutes

, in tubercle bacilli it is about 20 hours

and in lepra bacilli it is about 20 days.

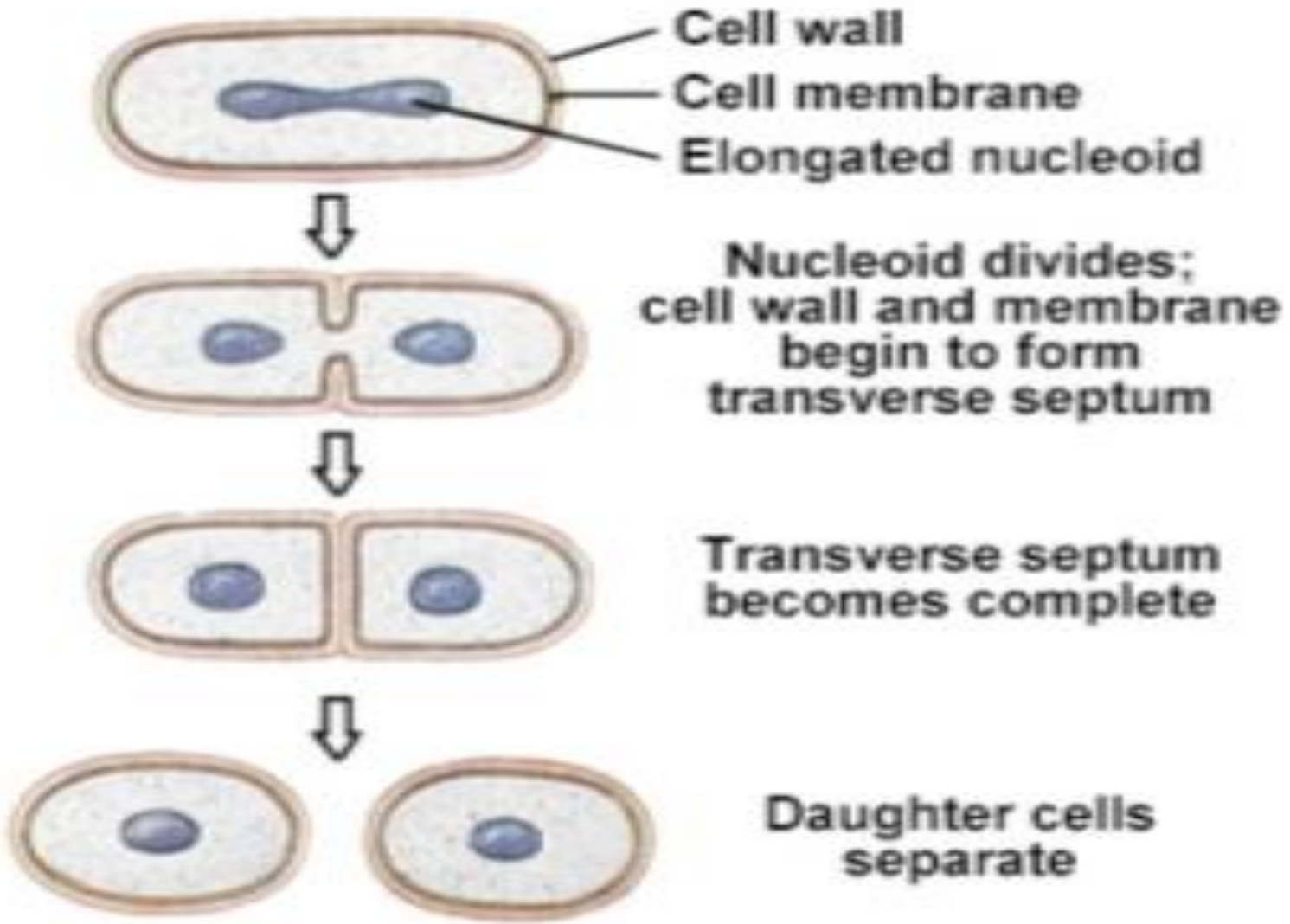


Fig 1 - Binary fission in bacteria

Bacterial Growth Curve

When a few bacteria are inoculated into a liquid growth medium and the population is counted at intervals, it is possible to plot a **bacterial growth curve** that shows the growth of cells over time .**There are four basic phases of growth: the lag, log, stationary, and death phases.**

Phases of Bacterial Growth Curve

1-Lag phase

When microorganisms are introduced into fresh culture medium, usually no immediate increase in cell number occurs, and therefore this period is called the lag phase. After inoculation, there is an increase in cell size at a time when little or no cell division is occurring. This initial period is the time required for adaptation to the new environment, during which the necessary enzymes and metabolic intermediates are built up in adequate quantities for multiplication to proceed.

2-Log (logarithmic) or exponential phase

Eventually, the cells begin to divide and enter a period of growth, or logarithmic increase, called the **log phase,** or **exponential growth phase.** Cellular reproduction is most active during this period, and generation time reaches a constant minimum. Because the generation time is constant and because each individual divides at a slightly different moment, the growth curve rises smoothly rather than in discrete jumps .The log phase is the time when cells are most active metabolically and is preferred for industrial purposes where, for example, a product needs to be produced efficiently.

Exponential phase is of limited duration because of

1-exhaustion of nutrients

2- accumulation of toxic metabolic end products

3-rise in cell density,

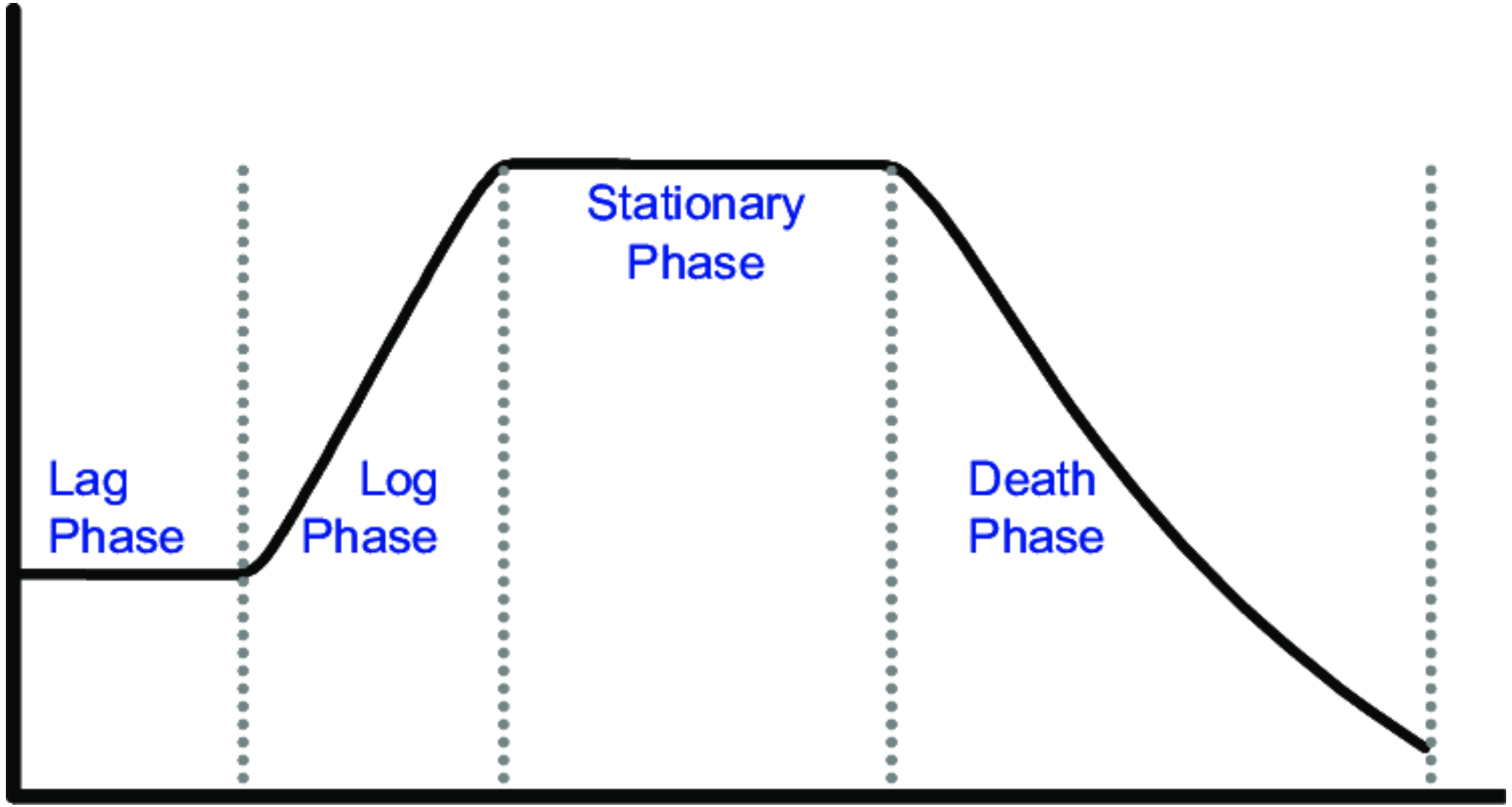
4- change in pH; and decrease in oxygen tension

3-Stationary phase

After a varying period of exponential growth, cell division stops due to depletion of nutrients and accumulation of toxic products. Eventually growth slows down, the growth rate slows, the number of microbial deaths balances the number of new cells, and the population stabilizes..

4-Decline or death phase

The death phase is the period when the population decreases due to cell death. Eventually the rate of death exceeds the rate of reproduction, and the number of viable cells declines.



Bacterial growth curve

Types of microbial cultures

1- batch cultures : Its closed system ,in which nutrient supplies are not renewed nor wastes removed , Exponential growth lasts for only a few generations and soon the stationary phase is reached

2- Continuous Culture. It is possible to grow microorganisms in an open system, a system with constant environmental conditions maintained through continual provision of nutrients and removal of wastes. These conditions are met in the laboratory by a **continuous culture system.**

There are two types of continuous culture

(1) chemostats :

(2) turbidostats:

Preserving Bacterial Cultures

1-Refrigeration: Refrigeration can be used for the short-term storage of bacterial cultures.

2- **Deep freezing:** is a process in which a pure culture of microbes is placed in a suspending liquid and quick-frozen at temperatures ranging from −50°C to −95°C.

3- **Lyophilization (freeze drying):** During lyophilization a suspension of microbes is quickly frozen at temperatures ranging from −54°C to −72°C, and the water is removed by a high vacuum: