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مدرس المادة :ا.م. د. علي حازم عبد الكريم

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Microbial Growth

The Requirements for Growth

I. The growth of a population is an increase in the number of cells.
2. The requirements for microbial growth are both physical and chemical.

Physical Requirements

3. On the basis of preferred temperature ranges, microbes are classified as psychrophiles (cold-loving), mesophiles (moderatetemperature-loving), and thermophiles (heat-loving).
4. The minimum growth temperature is the lowest temperature at which a species will grow, the optimum growth temperature is the temperature at which it grows best, and the maximum growth temperature is the highest temperature at which growth is possible.
5. Most bacteria grow best at a pH value between 6.5 and 7.5.
6. In a hypertonic solution, most microbes undergo plasmolysis; halophiles can tolerate high salt concentrations.

Chemical Requirements

7. All organisms require a carbon source; chemoheterotrophs use an organic molecule, and autotrophs typically use carbon dioxide.
8. Nitrogen is needed for protein and nucleic acid synthesis. Nitrogen can be obtained from the decomposition of proteins or from NH4 + or NO3 - ; a few bacteria are capable of nitrogen (N2) fixation.
9. On the basis of oxygen requirements, organisms are classifed as obligate aerobes, facultative anaerobes, obligate anaerobes, aerotolerant anaerobes, and microaerophiles.

10. Aerobes, facultative anaerobes, and aerotolerant anaerobes must have the enzymes superoxide dismutase (2 O2- + 2 H+ , O2 + H20 2) and either catalase (2 H20 2 ' 2 H20 + 0 2) or peroxidase (H20 2 + 2 H+ , 2 H20).
11. Other chemicals required for microbial growth include sulfur,

phosphorus, trace elements, and, for some microorganisms, organic growth factors.

Biofilms

I. Microbes adhere to surfaces and accumulate as biofilms on solid surfaces in contact with water.
2. Biofilms form on teeth, contact lenses, and catheters.
3. Microbes in biofilms are more resistant to antibiotics than are free swimming microbes.

Culture Media

I. A culture medium is any material prepared for the growth of bacteria in a laboratory.
2. Microbes that grow and multiply in or on a culture medium are known as a culture.
3. Agar is a common solidifying agent for a culture medium.

Chemically Defined Media

4. A chemically defined medium is one in which the exact chemical composition is known.

Complex Media

5. A complex medium is one in which the exact chemical composition varies slightly from batch to batch.

Anaerobic Growth Media and Methods

6. Reducing media chemically remove molecular oxygen (O2) that might interfere with the growth of anaerobes.
7. Petri plates can be incubated in an anaerobic jar, anaerobic chamber, or OxyPlate**.**

Special Culture Techniques

8. Some parasitic and fastidious bacteria must be cultured in living animals or in cell cultures.
9. CO2 incubators or candle jars are used to grow bacteria that require an increased CO2 concentration.
10. Procedures and equipment to minimize exposure to pathogenic microorganisms are designated as biosafety levels 1 through 4.

Selective and Differential Media

11. By inhibiting unwanted organisms with salts, dyes, or other chemicals, selective media allow

growth of only the desired microbes.
12. Differential media are used to distinguish different organisms.

Enrichment Culture

13. An enrichment culture is used to encourage the growth of a particular microorganism in a mixed culture.

Obtaining Pure Cultures

1. A colony is a visible mass of microbial cells that theoretically arose from one cell.
2. Pure cultures are usually obtained by the streak plate method.

Preserving Bacterial Cultures

1. Microbes can be preserved for long periods of time by deepfreezing or lyophilization (freeze-drying),

The Growth of Bacterial Cultures

Bacterial Division

1. The normal reproductive method of bacteria is binary fission, in which a single cell divides into two identical cells.
2. Some bacteria reproduce by budding, aerial spore formation, or fragmentation.

Generation Time

3. The time required for a cell to divide or a population to double is known as the generation time.

Logarithmic Representation of Bacterial Populations

4. Bacterial division occurs according to a logarithmic progression (two cells, four cells, eight cells, and so on).

Phases of Growth

5. During the lag phase, there is little or no change in the number of cells, but metabolic activity is high.
6. During the log phase, the bacteria multiply at the fastest rate possible under the conditions provided.

7. During the stationary phase, there is an equilibrium between cell division and death.
8. During the death phase, the number of deaths exceeds the number of new cells formed.

Direct Measurement of Microbial Growth

9. A standard plate count reflects the number of viable microbes and assumes that each bacterium grows into a single colony;

plate counts are reported as number of colony-forming units (CFU).
10. A plate count may be done by either the pour plate method or the spread plate method.
11. In filtration, bacteria are retained on the surface of a membrane filter and then transferred to a culture medium to grow and subsequently be counted.
12. The most probable number (MPN) method can be used for microbes that will grow in a liquid medium; it is a statistical estimation.
13. In a direct microscopic count, the microbes in a measured volume of a bacterial suspension are counted with the use of a specially designed slide.

Estimating Bacterial Numbers by Indirect Methods

14. A spectrophotometer is used to determine turbidity by measuring the amount of light that passes through a suspension of cells.
15. An indirect way of estimating bacterial numbers is measuring the metabolic activity of the population (for example, acid production or oxygen consumption).
16. For filamentous organisms such as fungi, measuring dry weight is a convenient method of growth measurement.

References': 1- Microbiology an introduction TENTH EDITION. Gerard. Tortora.2010.

. 2-Microbiology an introduction TWELFTH EDITION. Gerard. Tortora.2016