

Macroscopic and Microscopic Morphology of Bacteria



Morphological Properties of Bacteria

- Macroscopic Morphology (Bacterial Colony Morphology)
- Microscopic Morphology (Cellular Morphology of Bacteria)

Macroscopic Morphology of Bacteria



Commonly Used Media in Microbiology

- Nutrient Agar (NA)
- Trypticase Soy Agar (TSA)
- Sheep Blood Agar (SBA)
- MacConkey Agar (MA)
- Chocolate Agar
- Muller Hinton Agar
- Saborraud Dextrose Agar

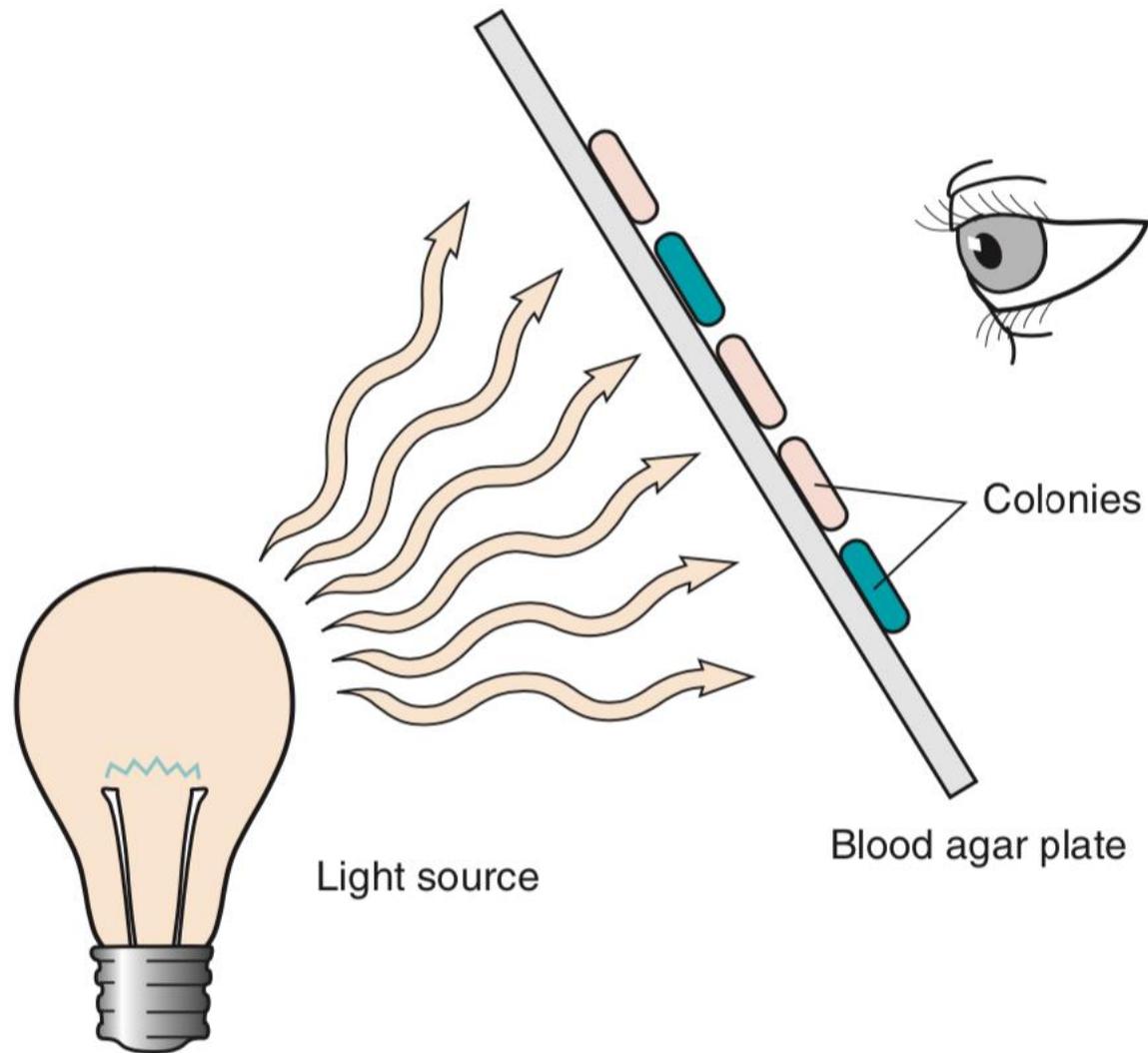


FIG. 8.5 The use of transillumination to determine whether colonies are hemolytic. The technique can be used for MacConkey agar also to see slight color differences in nonlactose fermenters.



Macroscopic Colony Characteristics for Identification & Differentiation of Microorganisms

- Hemolysis
- Size
- Colonial Form
- Elevation
- Density
- Color
- Consistency
- Pigment
- Odor

Hemolysis

- Greek; **hemo**:related to red blood cells + **lysis**:dissolution/break apart
- observed in the medium immediately surrounding or underneath the colony
- a reaction caused by enzymatic or toxin activity of bacteria
 - Alfa-hemolysis / alfa-hemolytic bacteria: partial lysis of RBCs
 - Beta-hemolysis / beta-hemolytic bacteria: complete lysis of RBCs
 - Gama-hemolysis / non-hemolytic bacteria

BLOOD AGAR: Enrichment media, and Differential



beta-hemolysis
Streptococcus pyogenes



alpha hemolysis
Escherichia coli



gamma hemolysis (no hemolysis)
Staphylococcus epidermidis



119 Beta-haemolytic streptococcus on sheep blood agar.

Size

- Colonies are described as **large, medium, small, or pinpoint.**
- Size is generally a visual comparison between genera or species.
- Gram-positive bacteria generally produce smaller colonies than Gram-negative bacteria.
- *Staphylococcus* species are usually larger than *Streptococcus* species.

Colonial Form / Shape

- The edge of the colonies should be observed and the form, or **margin**, described as **smooth**, **filamentous**, **rough** or **rhizoid**, or **irregular**
- Colonies of *Bacillus anthracis* on visual examination are described as “Medusa heads” because of the filamentous appearance.
- Certain genera such as *Proteus* spp. may swarm on nonselective agar such as blood or CHOC agar. **Swarming** is a hazy blanket of growth on the surface that extends well beyond the streak lines.
- Diphtheroids produce colonies that have a dry appearance.
- Certain yeasts produce colonies that are creamy, white with a dull surface, and described as colonies with feet or pedicles, whereas staphylococci produce moist, creamy white to yellowish colonies.

Elevation

- The **elevation** should be determined by tilting the culture plate and looking at the side of the colony.
- Elevation may be raised, **convex**, **flat**, **umbilicate** (depressed center, concave), or **umbonate** (raised or bulging center, convex).
- *S. pneumoniae* typically produces umbilicate colonies, unless the colonies are mucoid because of the presence of a polysaccharide capsule.
- *S. aureus* typically produces convex colonies.
- In comparison, β -hemolytic streptococci generally produce flat colonies.

Density

- The **density** of the colony can be **transparent, translucent, or opaque**.
- To see the differences in the density of colonies, it is useful to look through the colony while using transillumination.
- Translucent colonies allow some light to pass through the colony and opaque colonies do not.
- β -Hemolytic streptococci except group B (*S. agalactiae*) are described as translucent.
- *S. agalactiae* produces colonies that are semiopaque, with the organisms concentrated at the center of the colony, sometimes described as a **bull's-eye colony**.
- Staphylococci and other gram-positive bacteria are usually opaque.
- Most gram-negative rods also form opaque colonies.
- *Bordetella pertussis* is described as shiny, similar to a half-pearl, on blood-containing media

Color

- In contrast to pigmentation, color is a term used to describe a color of bacterial colonies on agar media.
- Colonies may be **white, gray, yellow**.
- Coagulase-negative staphylococci are white, whereas *Enterococcus* spp. may appear gray.
- Certain *Micrococcus* spp. and *Neisseria* spp. (nonpathogenic) are yellow or off-white.
- *S. aureus* are yellow.
- Most Gram-negative rods are gray on SBA

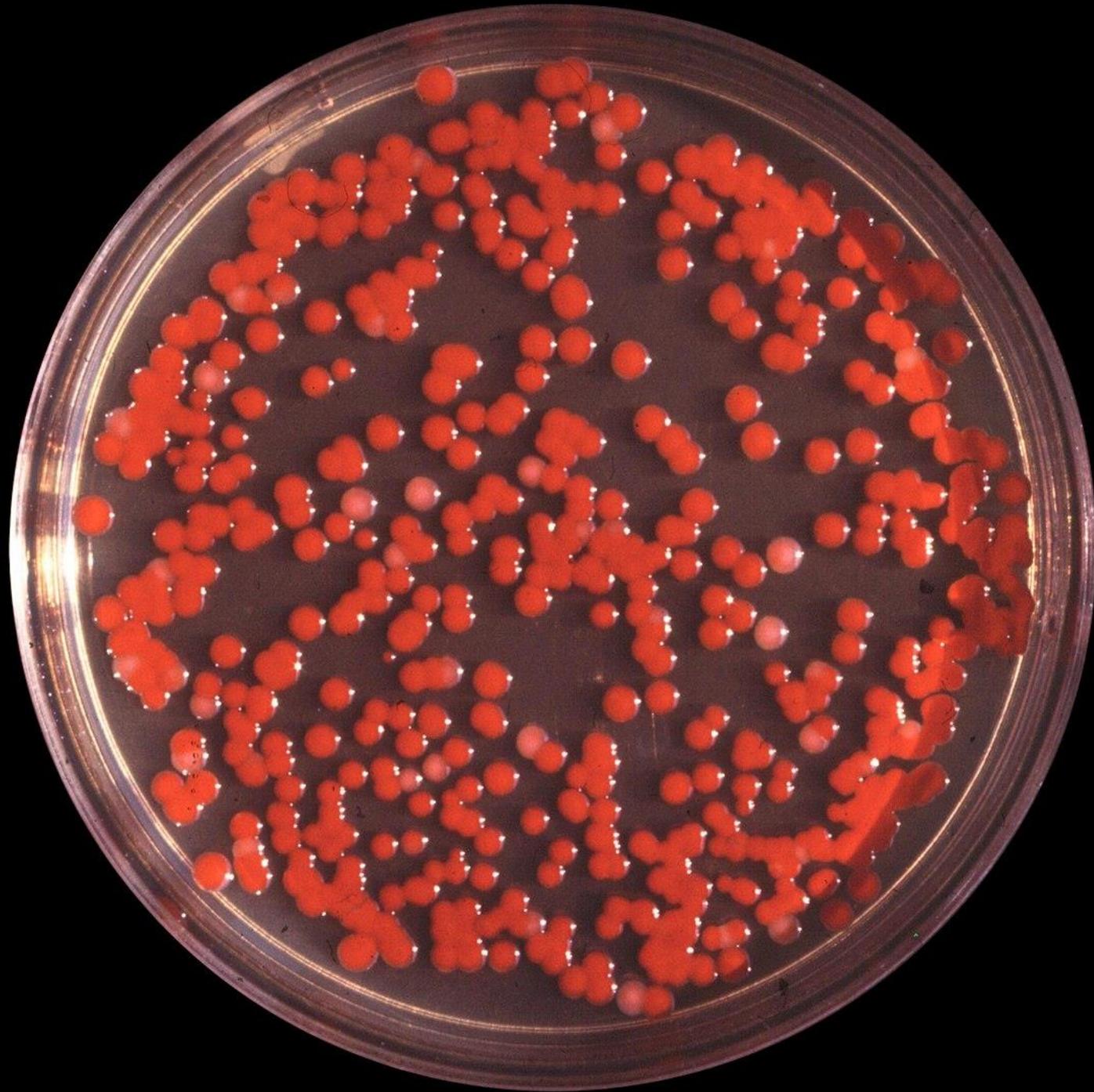
Consistency

- **Consistency** is determined by touching the colony with a sterile loop.
- Colony consistency may be **brittle** (splinters), **creamy (butyrous)**, dry, or waxy; occasionally, the entire colony adheres (sticks) to the loop.
- *S. aureus* is creamy, whereas certain *Neisseria* spp. are sticky.
- *Nocardia* spp. produce colonies that are brittle, crumbly, and wrinkled, resembling bread crumbs on a plate.
- Most β -hemolytic streptococci are dry (except for mucoid types), and when pushed by a loop, the whole colony remains intact.
- *Klebsiella* spp. are mucoid.

Pigment

- **Pigment** production is an inherent characteristic of a specific organism confined generally to the colony, although some pigments will diffuse through the culture medium.
- Pigment production is generally enhanced by growing bacteria at room temperature.
- Examples of organisms that produce pigment include the following:
 - *Pseudomonas aeruginosa*—green, sometimes a metallic sheen
 - *Serratia marcescens*—brick red, especially at room temperature





Odor

- Odor should be determined when the lid of the culture plate is removed and the odor dissipates into the surrounding environment. The microbiologist should never inhale directly from the plate.
- Examples of microorganisms that produce distinctive odors are as follows:
- *S. aureus*—old sock (stocking that has been worn continuously for a few days without washing); this odor is evident when bacteria are growing on mannitol salt agar
- *P. aeruginosa*—fruity or grapelike
- *Salmonella* spp.-sperma

Growth of Bacteria in Liquid Media

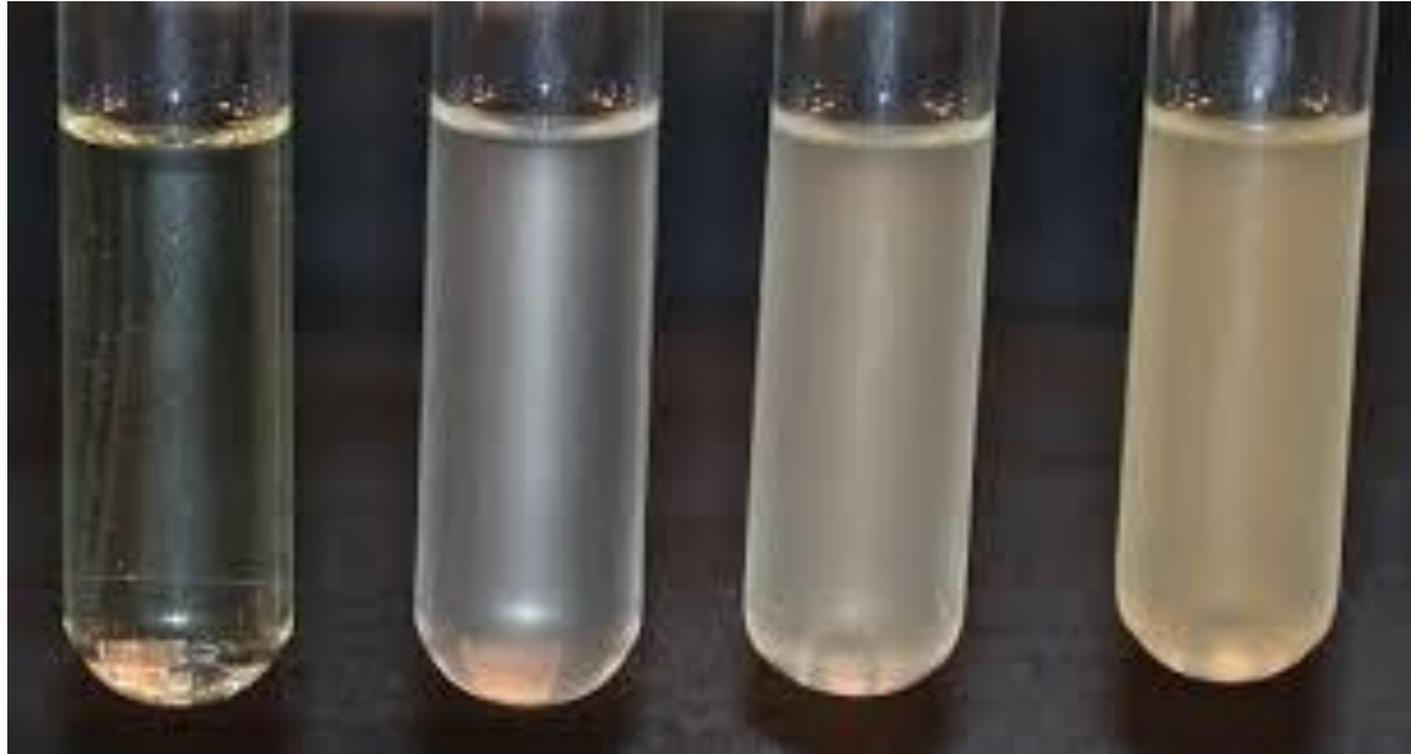


TABLE 6.1 The Effect of Oxygen on the Growth of Various Types of Bacteria

	a. Obligate Aerobes	b. Facultative Anaerobes	c. Obligate Anaerobes	d. Aerotolerant Anaerobes	e. Microaerophiles
Effect of Oxygen on Growth	Only aerobic growth; oxygen required.	Both aerobic and anaerobic growth; greater growth in presence of oxygen.	Only anaerobic growth; ceases in presence of oxygen.	Only anaerobic growth; but continues in presence of oxygen.	Only aerobic growth; oxygen required in low concentration.
Bacterial Growth in Tube of Solid Growth Medium					
Explanation of Growth Patterns	Growth occurs only where high concentrations of oxygen have diffused into the medium.	Growth is best where most oxygen is present, but occurs throughout tube.	Growth occurs only where there is no oxygen.	Growth occurs evenly; oxygen has no effect.	Growth occurs only where a low concentration of oxygen has diffused into medium.
Explanation of Oxygen's Effects	Presence of enzymes catalase and superoxide dismutase (SOD) allows toxic forms of oxygen to be neutralized; can use oxygen.	Presence of enzymes catalase and SOD allows toxic forms of oxygen to be neutralized; can use oxygen.	Lacks enzymes to neutralize harmful forms of oxygen; cannot tolerate oxygen.	Presence of one enzyme, SOD, allows harmful forms of oxygen to be partially neutralized; tolerates oxygen.	Produce lethal amounts of toxic forms of oxygen if exposed to normal atmospheric oxygen.

Microscopic Morphology of Bacteria



References

1. Quinn PJ, Markey BK, Leonard FC, FitzPatrick ES, & Fanning S (2011). *Veterinary Microbiology and Microbial Disease*. 2nd Ed., Wiley-Blackwell.
2. Tortora GJ, Funke BR, Case CL (2019). *Microbiology, An Introduction*. 13rd Edition, Pearson Education Inc.