
Lecture-7th.: Bacillus:

After this lecture you would be able to:

- ✓ Describe the cellular and colonial characteristics of ***Bacillus anthracis.***
- ✓ Understand the laboratory diagnosis of **anthrax**
- ✓ Describe ***B. cereus*** which causes food poisoning.

General characteristics of Bacillus:

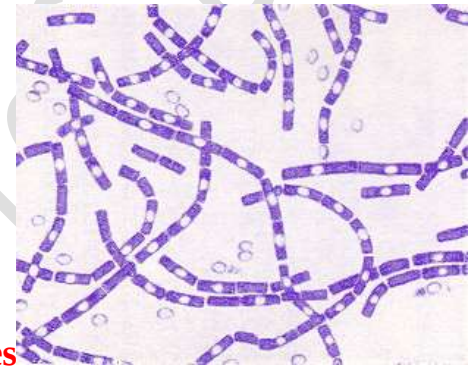
1. The genus *Bacillus* consists **aerobic** bacilli forming heat resistant **spores**.
2. They are **gram-positive**.
3. *Bacillus anthracis* is **non-motile.**
4. The genus includes **psychrophilic**, **mesophilic** and **thermophilic** species.

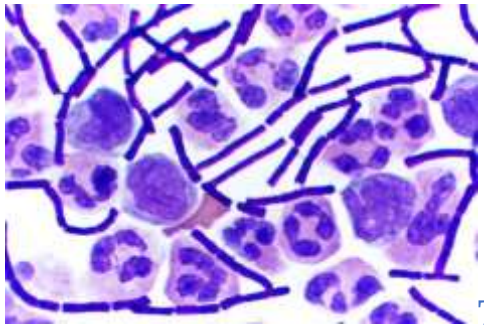
Morphology: 1- *B. anthracis* is **gram-positive**, **spore forming bacillus**. **2-** In cultures, the bacilli are **arranged end to end forming long chains.** **3-** The ends of the bacilli are concave and somewhat swollen so that the chain of bacilli presents is '**bamboo stick' appearance**.

4- The spore is **oval** (ellipsoidal), **refractive**, **central in position and the same diameter as the bacillus, therefore, not swelling the mother cell**. Spores seen as **unstained spaces in Gram-stained bacilli**.

5- The cell is surrounded by a **capsule** which is **polypeptide** in nature, composed of **D– glutamic acid.**

The Spores





The cells

Cultural Characteristics

It is aerobe and facultative anaerobe. Temperature range for growth is 12-45°C (**optimum 37°C**). Optimum pH for growth is 7.4.

1- **On nutrient agar**: On nutrient agar, **colonies are irregularly round**, 2-3 mm in diameter, **raised**, **opaque**, **grayish white**, with a **frosted glass appearance**. **The**

edge of the colony is composed of long, interlacing chains of bacilli; resembling '<u>Medusa</u> head appearance' as in figure below.


<u>Medusa</u> head appearance colonies

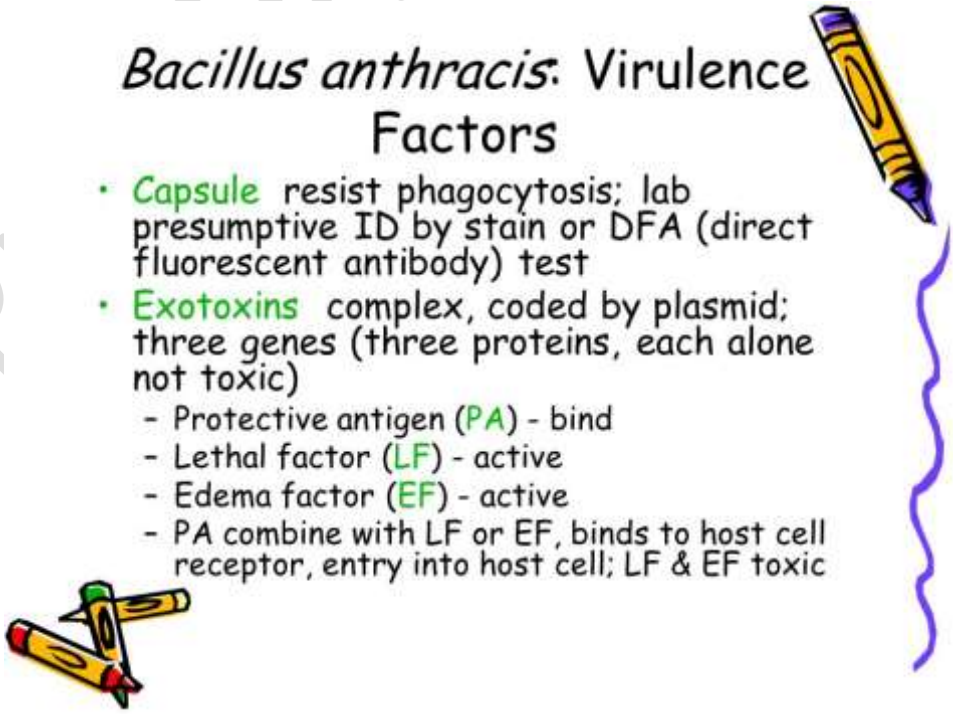
2. **On blood agar:** Colonies on horse or sheep blood agar are **non-hemolytic**.

3. **In broth:** Growth develops **silky strands**, a **surface pellicle floccular deposit**.

4. In a gelatin stab, there is growth down the stab line with lateral spikes, longer near the surface, giving an **'inverted fir tree'** appearance with slow liquefaction commencing from the top.

5. **Selective medium:** A selective medium for *B. anthracis* is; (**<u>PLET</u>** medium), consisting of **polymyxin**, **lysozyme**, **ethylene diamine tetra acetic acid** (EDTA) and **<u>Thallous</u> acetate** added to **heart infusion agar**, **is used to isolate *B. anthracis* from mixtures containing other spore-bearing bacilli.**

Biochemical Reactions: *B. anthracis* ferments **glucose**, **maltose**, **sucrose**, **Trehalose** and **dextrin** with the production of acid without gas. **Nitrates are reduced to nitrites. Catalase is positive.** There is a weak **lecithinase** reaction on **egg-yolk agar which gives a narrow zone of opalescence around the colonies.**



Anthrax: anthrax is a **zoonotic disease** (**it is transmitted between animals and human**). It is mainly of animal disease and transmits from animals to human by different ways causing **three types of anthrax disease depending on the site of entry**; either **cutaneous** anthrax (the common and treatable type), **pulmonary** anthrax (**wool's sorter disease**, fatal) or **gastrointestinal** anthrax.

1- **On the skin = cutaneous anthrax. it is common and treatable.**
2- **Inhalation into the lung = Pulmonary (wool's sorter). It is fatal.**
3- **Ingestion = gastrointestinal anthrax**

Cutaneous anthrax on the neck

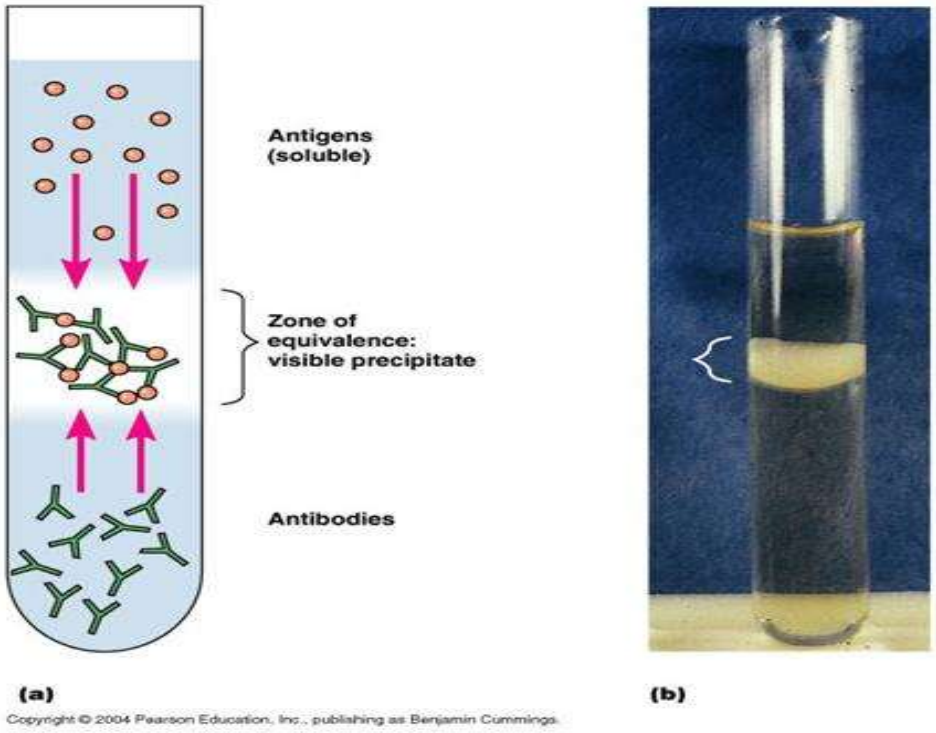
Cutaneous Anthrax

- Most common (95% infections)
- Spores enter exposed skin, germinate, multiply
- Exotoxin released, rapid development of pustule
- Occasionally, MO disseminate - septicemia, death in few days
- Vascular injury - edema, hemorrhage, thrombosis
- Death - respiratory failure, anoxia by toxin on CNS
- Mortality ~20% if untreated

Cutaneous (pustule) anthrax on the arm of man

Diagnosis:

1- **Ascoli test: it is serological, ring precipitin test using an extract of infected tissue and anthrax antiserum.**



2- **McFadyean reaction:** It is special staining reaction, demonstrating a **pink capsule around a blue cell using polychrome methylene blue stain**.

B. anthracis

McFadyean reaction(polychrome MB stain)

Bacillus cereus: it is a normal inhabitant of the soil, but it can be regularly isolated from foods such as grains and spices. *B. cereus* causes **two types of food-borne intoxications**. **One** type is characterized by **nausea**, **vomiting** and **abdominal cramps** and has an incubation period of **1 to 6 hours**. **This is the "short-incubation" or emetic form of the disease caused by (heat-stable emetic toxin)**. The **second** type causes **abdominal cramps and diarrhea** with an incubation period of **8 to 16 hours** . Diarrhea may be a small volume or profuse and watery. This type is referred to as the **"long-incubation" or diarrheal form of the disease caused by the heat-labile diarrhea-genic enterotoxin**. In either type, the illness usually lasts less than 24 hours after onset.

Comparison between *B. anthracis* and *B. cereus*:

B. anthrax vs B. cereus

Sr. No.	Feature	B. anthrax	B. cereus
1	Pathogenicity	Anthrax	Food poisoning
2	Capsule	Poly D-glutamic acid	Absent
3	Motility	Non motile	Motile
4	Source of infection	Spores from animal products	Spores on grains and reheated fried rice
5	Portal of Entry	Skin, Respiratory tract,GIT	GIT
6	Virulence factors	Anthrax toxin, Capsule; inhibits phagocytosis and opsonization	Two types of enterotoxinss; one increases the conc. Of cAMP in gut and 2nd act as super Ag
7	Clinical features	Pinsless ulcers with black crust, edema, lesion, bacteremia, lymphadenitis	Nausea, vomiting, watery and non bloody diarrhea

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