

فسيولوجيا الأحياء الدقيقة Microbial Physiology

د. تركي محمد الداود
مكتب ٢ ب ٤٥

**Bacterial Growth &
Environmental Effects
L10**

Low Nutrient Levels

- ❖ Apart from water, every other component needs to be taken from the environment to allow growth.
- ❖ Most natural ecosystems are characterised by low nutrient levels.
- ❖ Bacteria must be able to survive time of starvation.
- ❖ When amino acid levels are reduced, most bacteria exhibit **stringent response**.
- ❖ Protein translation and other macromolecular synthesis reduction by decreasing transcription of ribosomal RNA.
- ❖ Allowing the cell to enter a **hibernation-like state**.
- ❖ Low levels of ammonia (nitrogen) cause the synthesis of a glutamine synthetase enzyme.
- ❖ This enzyme catalyses and ATP-dependent assimilation of glutamine from very low levels of ammonia.

Low Nutrient Levels

- ❖ This glutamine amino nitrogen group can then be transferred to other amino acids (glutamate) that supply the nitrogen-containing molecules for the cell.
- ❖ If phosphate is limiting, *E. coli* synthesises over 100 proteins.
- ❖ This ultimately leads to the over production of alkaline phosphatase which enable the cell to obtain phosphate from organic sources.

Oxygen Dependence

- ❖ During aerobic metabolism, oxygen radicals are formed which can destroy proteins and membranes (tea is full of anti-oxidants, oxygen radical blamed for the ageing process).
- ❖ The ability of bacteria to cope with these oxygen radicals defines the aerobic nature.
- ❖ Three enzymes are important in the detoxification of these oxygen radicals:
 - Catalase.
 - Peroxidase.
 - Superoxide dismutase.
- ❖ Obligate and facultative aerobes produce these enzymes and are able to cope with the toxic oxygen radicals.

Oxygen Dependence

- ❖ Microaerophiles have a reduced ability to detoxify these compounds, and can only survive in low oxygen concentrations .
- ❖ Obligate anaerobes do not produce these enzymes, and are destroyed by oxygen.

Low Water Availability:

- ❖ Most bacteria require water to be easily available to grow and replicate.
- ❖ some bacteria have adapted to low water availability.
- ❖ Xerophiles are very resistant to desiccation.
- ❖ Most important physiological adaptation are a slow growth rate and the production of capsule or slime layers.

Light Availability:

- ❖ Phototrophs all require light as part of their metabolism.
- ❖ Possessing a phototactic capability, flagellated bacteria are able to move towards regions of high light.
- ❖ Many aquatic bacteria are dependent on phototrophy, and depending on the light density.
- ❖ However too much light can be dangerous.
- ❖ Light especially UV irradiation can be potentially dangerous to a cell.
- ❖ For protection, they produce pigments and carotenoids that absorb the Light before it can be damage the cell.

QUESTIONS??

