

NUTRITION AND GROWTH OF BACTERIA

By:

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INTRODUCTION

- Bacteria are prokaryotic organisms that do not contain chlorophyll. They are unicellular. They differ from eukaryotes in not having a nuclear membrane , a nucleolus, and cell organelles like mitochondria, golgi apparatus and endoplasmic reticulum. They have a single circular chromosome.

GROWTH OF BACTERIA

- **Bacterial nutrition:**

The bacterial cell has the same general chemical pattern as the cells of other organisms. The bacterial cell contains water (80% of total weight), proteins, polysaccharides, lipids, nucleic acids, mucopeptides and low molecular weight compounds.

- For growth and nutrition of bacteria, the minimum nutritional requirements are water, a source of carbon, a source of nitrogen and some inorganic salts. Water is the vehicle of entry of all nutrients into the cell and for the elimination of waste products.

- Bacteria can be classified nutritionally based on their energy requirements and on their ability to synthesise essential metabolites. Into:

1- **Phototrophs:**

Bacteria which derive energy from sunlight.

2- **Chemotrophs:**

Those that obtain energy from chemical reactions.

3. **Autotrophs:**

Bacteria that can synthesise all their organic Compounds. They are able to use atmospheric carbon dioxide and nitrogen. They are capable of

independent existence in water and soil. They are of no medical importance.

4. Heterotrophs:

Bacteria are unable to synthesise their own metabolites. They depend on preformed organic compounds. These bacteria are unable to grow with carbon dioxide as the sole source of carbon. Their nutritional requirements vary widely. Some may require only a single organic substance like glucose. Others may need a large number of

different compounds like amino acids, nucleotides, lipids, carbohydrates and coenzymes.

- Bacteria require a supply of inorganic salts. They require anions like phosphate and sulphate anions and cations like sodium, potassium, magnesium, iron and calcium. Some ions like cobalt may be required in trace amounts.
- Some bacteria require certain organic compounds in minute quantities. These are called **growth factors** or bacterial vitamins. Growth factors are called **essential** when growth does not occur in their absence. **Accessory** growth factors are those which enhance growth without being absolutely necessary for it.

- In many cases, bacterial vitamins are same as vitamins necessary for nutrition of mammals, for example, B group vitamins – thiamine, riboflavin, pyridoxine, nicotinic acid, folic acid and vitamin B12.

Gaseous Requirements

- Depending on the influence of oxygen on growth and survival, bacteria are divided into obligate aerobes , obligate anaerobes, facultative anaerobes and Microaerophilic bacteria.

Obligate aerobes:

Grow only in the presence of oxygen, for eg. Cholera bacillus.

Obligate anaerobes:

Such as clostridia grow in the absence of oxygen.
May even die on exposure to oxygen.

Facultative anaerobes:

Are ordinarily aerobic but can grow in the absence of oxygen.

Most bacteria of medical importance are facultative anaerobes.

Microaerophilic bacteria:

Are those that grow best in the presence of low oxygen tension.

- All bacteria require some amounts of carbon dioxide for growth. This is obtained from the atmosphere or from the cellular metabolism of the bacterial cell. Some bacteria like *Brucella abortus* require much higher levels of carbon dioxide (5-10%) for growth. They are called **capnophilic**.

Temperature Requirements

- Bacteria vary in their requirement of temperature for growth. For each species, there is a “**temperature range**”, and growth does not occur above the maximum or below the minimum of this range. The temperature at which growth occurs best is known as the “**optimum temperature**”. In the case of most Pathogenic bacteria, the optimum temperature is 37c°.

Mesophilic bacteria:

Bacteria which grow best at temperatures of 20-45 c°. For example *Escherichia coli*.

Psychrophilic bacteria:

Are those that grow best at temperatures below 15 c°. They are soil and water saprophytes and may cause spoilage of refrigerated food.

Thermophilic bacteria:

Are those which grow best at high temperatures, 41 and 122 c°.

They may cause spoilage of underprocessed canned food. Some thermophiles, for example *Geobacillus stearothermophilus*, form spores that are highly thermoresistant.

Other physiological Requirements

- Moisture and drying, hydrogen ion concentration, light, osmotic effect and mechanical and sonic stress may also influence the growth and multiplication of bacteria.