CHAPTER I: INTRODUCTION

ENERGY, ANABOLISM and CATABOLISM

Microorganisms are capable of performing a wide variety of biochemical reactions that result in the production of biomass (cell bodies) and the degradation, transformation, or production of organic or mineral substances.

For their survival (maintenance), development (growth and multiplication), and expression of their properties (mobility, luminescence, etc.), microorganisms require energy and nutrients. The necessary energy is obtained from the environment, either directly in the form of light energy or indirectly in the form of chemical energy through the oxidation of organic or mineral substances.

Microbial biochemistry is the study of the biochemical reactions involved in microbial growth and the different modes and mechanisms (processes) of pathogenesis that help us understand infections (diseases) in hosts. It includes the study of microbial growth, the structure of microbial cells, microbial metabolism, primary and advanced functions, and the interactions of biological macromolecules (carbohydrates, proteins, fatty acids, lipids, and nucleic acids) that contribute to the skeletal aspect of the bacterial cell and are fundamental to the functions related to its life.

The term "***metabolism***" refers to the entire set of chemical reactions occurring in living cells: there is construction (***anabolism***), degradation (***catabolism***), or modification of molecules, oxidation or reduction of various atoms (Fig. 01). Most of these reactions require the intervention of specific protein catalysts called ***enzymes***.

Catabolism is the set of reactions that allow for the recovery of biologically usable energy and the production of basic metabolites from organic substrates or cellular reserves. This degradation is more or less complete and leads to the formation of metabolites (catabolic waste).

Anabolism is the set of cellular synthesis reactions from basic metabolites derived from catabolism and elements from the environment.

During catabolism, energy is converted from one form to another, and in accordance with the laws of thermodynamics, such energy transformations are never completely efficient, meaning that some energy is lost in the form of heat.

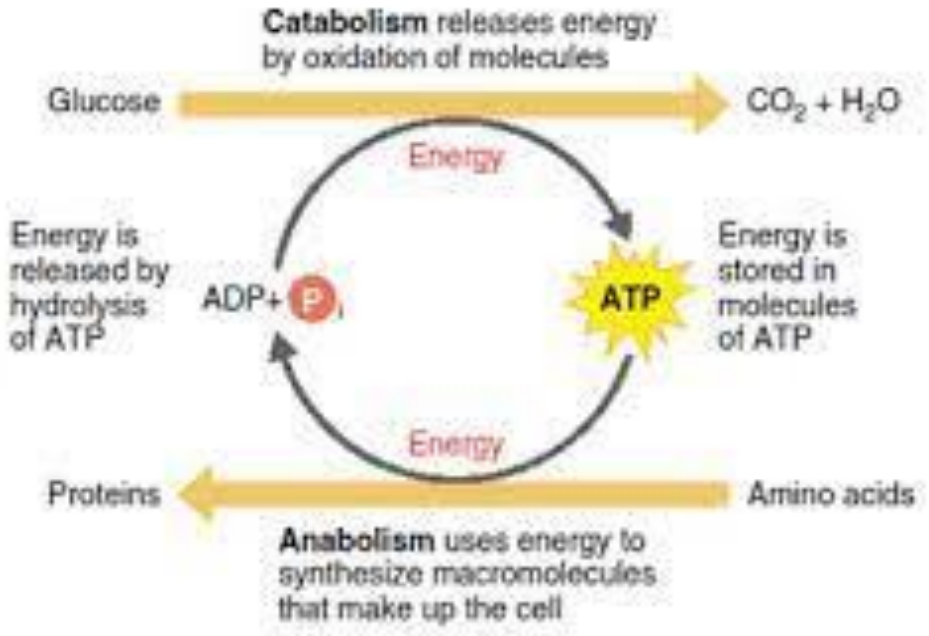

Figure 01: Simplified schematic representation showing the relationship between catabolism and anabolism in a cell.

The products released by metabolism during a growth phase (formed during the exponential phase) are called "***primary metabolites***," regardless of their origin, whether from catabolism or anabolism. These are non-specific products (amino acids, nucleotides, vitamins, organic acids, ethanol).

The term "***secondary metabolite***" is used for products specific to anabolism, whose appearance is not linked to the actual growth phase (most often occurring at the end of the exponential growth phase or during the stationary phase). These include antibiotics, immunosuppressants, hypocholesterolemic agents, antitumor agents, and bioinsecticides (Fig. 02).

Bacterial metabolism is characterized by certain features:

1. All metabolic processes occur in a unicellular organism;

2. It is non-compartmentalized;

3. Bacterial metabolism is very flexible (bacteria adapt quickly to environmental conditions);

4. It is characterized by the intensity of metabolic processes.

To maintain themselves, grow, and reproduce, bacteria must find favorable physicochemical conditions in the external environment as well as the necessary nutrients.

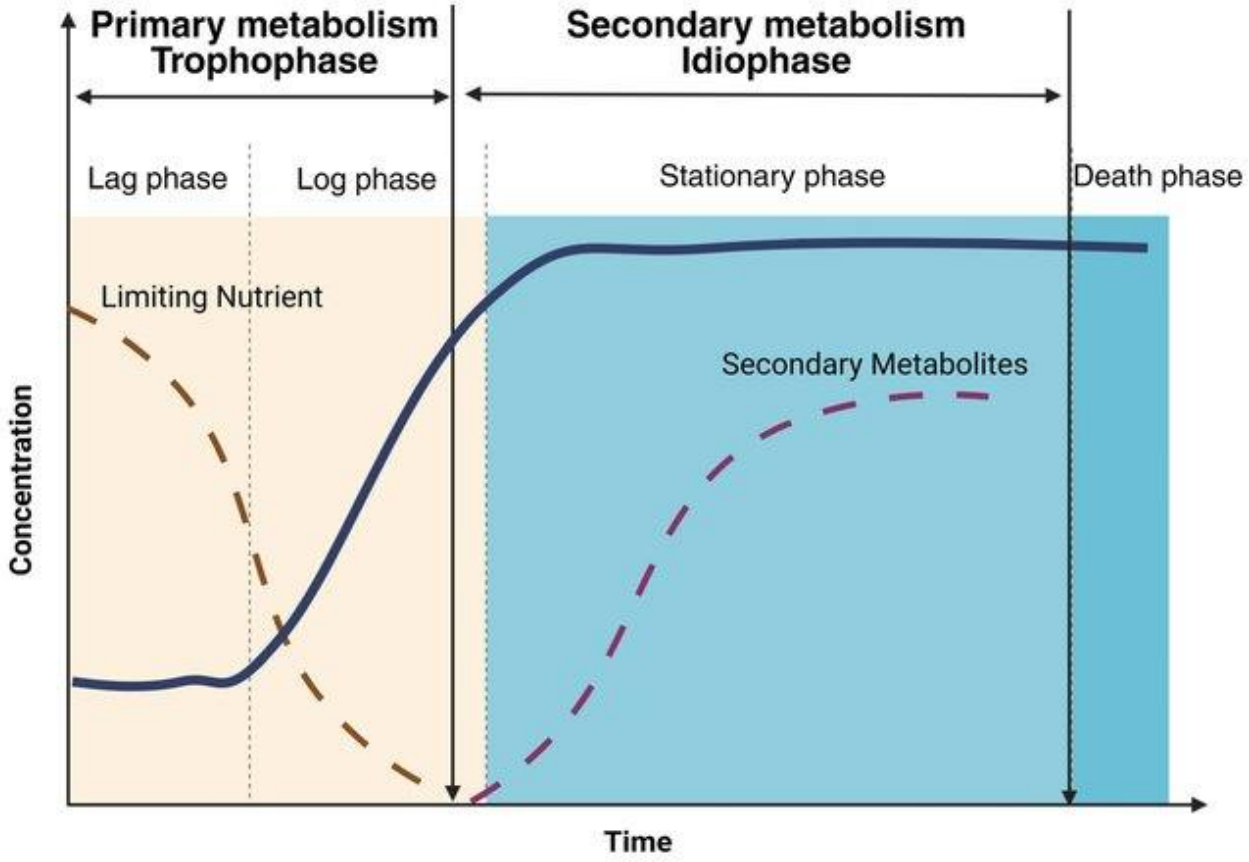

Figure 02: Formation of metabolites during bacterial growth (Trophophase/Idiophase