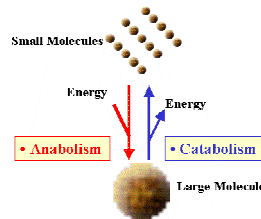


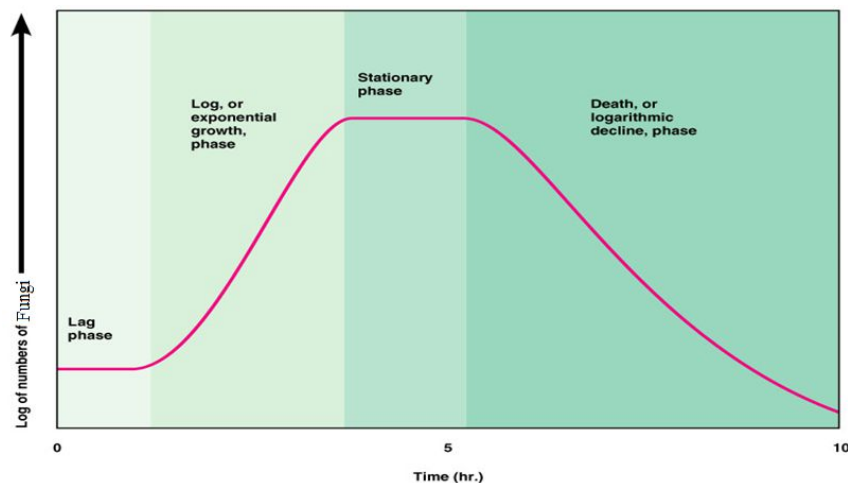
## Fungal Metabolism

**Metabolism** is a term that is used to describe all chemical reactions involved in maintaining the living state of the cells and the organism. Metabolism can be conveniently divided into two categories:

- Catabolism - the breakdown of molecules to obtain energy
- Anabolism - the synthesis of all compounds needed by the cells



**Primary metabolites:** are essential compounds for growth to occur and include proteins, carbohydrates, nucleic acids and lipids. These primary products must be synthesized if they cannot be obtained from the growth medium. These primary metabolites have essential and obvious roles to play in the growth of the fungus. Typically, primary metabolites are associated with the rapid initial growth phase of the organism and maximal production occurs near the end of this phase. Once the fungus enters the stationary phase of growth, however, primary metabolites may be further metabolized. Examples of primary metabolites produced in abundance: enzymes, fats, alcohol and organic acids as well as, low molecular weight compounds.



**Fig.1: Growth curve or phases of the fungal growth**

Primary metabolism is used for:

- 1 Growth and development of hyphal structure
- 2 Energy metabolism
- 3 Regulation of metabolism
- 4 Intermediate in biosynthesis of compound.

**Secondary metabolites;** Organic compounds , with low molecular weight ,which are not essential for fungal growth but their natural production have certain significances. Furthermore, secondary metabolites are derived from a few common biosynthetic pathways which branch off the primary metabolic pathways and are often produced as families of related compounds, often specific for a group of organisms. Fungi are a rich source of secondary metabolites and have been of interest for humans for thousands of years.

Secondary metabolism is used for:

- 1 competition
- 2 antagonism
- 3 self-defense mechanisms against other living organisms to allow the fungus to occupy the niche and utilize the food.

### **Types of Fungal secondary metabolites**

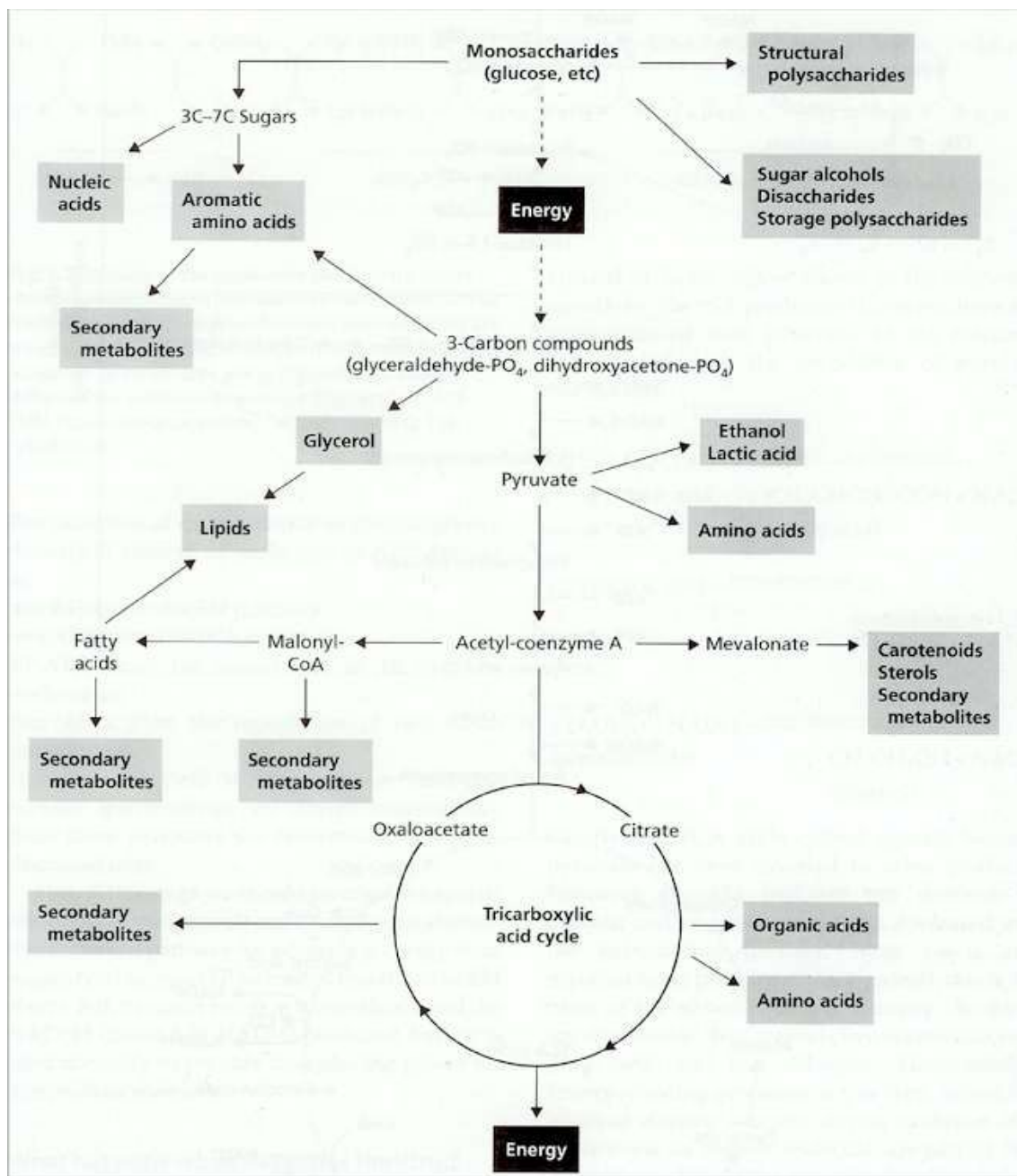
1. Strobilurin (antifungal)
2. Gibberellins (growth Hormons)
3. Herbicides (control weeds)
4. Mycotoxins (poisneous)
5. Insecticides ( control insects)
6. Enzymes (proteins)
7. Pigments (dyes)
8. Antibiotics (drugs)
9. Pharmacological drugs

## Differences between primary metabolism and secondary metabolism

| Primary metabolism                                  | Secondary metabolism                                         |
|-----------------------------------------------------|--------------------------------------------------------------|
| Function are known                                  | Function are usually unknown- lack                           |
| Widely distributed in nature                        | Only found in few species or genera                          |
| Usually used for growth, energy and as intermediate | Produced usually after growth has stopped                    |
| Examples: Pyruvate, lactic acid, ethanol            | Examples: Penicillin, cephalosporin, gibberellin, lovastatin |

Importance or the reasons for interest in secondary metabolites

- industries:
  - i. Antibiotic: Penicillin and cephalosporin
  - ii. Itaconic acid: cloth industries
  - iii. Gibberellin: plant growth regulator
  - iv. Animal feed
- Pigment
- Bioluminescence



**Fig. 2: Overview of the central metabolic pathways of fungi, showing how the main energy-yielding pathway (the Embden–Meyerhof pathway and the tricarboxylic acid cycle) provide the precursors for biosynthesis of various metabolic products (shaded boxes). Note that only some of the intermediates of the central metabolic pathway are shown for more details. Also, note that secondary metabolites (including penicillins and mycotoxins) are produced from various precursors, but primarily from acetyl coenzyme A.**