NUTRITION IN FUNGI

Nutritional requirements in Fungi

- Fungi are heterotrophic in nutrition
- They are chlorophyll deficient organisms, hence cannot manufacture carbohydrates.
- With simple structural organization, they mostly dependent on dead or living organic matter for their energy requirements
- All fungi are CHEMOHETEROTROPHIC (chemo-organotrophic) - synthesizing the organic compounds they need for growth and energy from pre-existing organic sources in their environment, using the energy from chemical reactions

- **Since their protoplasm is protected by a rigid wall, fungi must obtain their nutrients by the process of absorption**
- **Small molecules (e.g. simple sugars, amino acids) in solution can be absorbed directly across the fungal wall and plasma membrane**
- **Larger, more complex molecules (e.g. polymers such as polysaccharides and proteins) must be first broken down into smaller molecules, which can then be absorbed**
- **This degradation takes place outside the fungal cell or hypha and is achieved by enzymes which are either released through or are bound to the fungal wall**
- **Because these enzymes act outside the cell they are called Extracellular enzymes**

Essential Elements

- These elements which fungi require as food are termed the essential elements
- Some of these, the fungi need in extremely small trace amounts (Micro elements) and the others in comparatively larger amounts (macro elements)
- The constituent elements of the organic and inorganic substances which fungi make use of are C, O, H, N, P, K, Mg, S, P, Mn, Cu, Mo, Fe, Zn and Calcium
- The macro elements are body builders and provide energy for metabolic processes

Sources of Macro Elements

- The organic substances usually utilized by fungi are very varied in nature
- The carbohydrates are needed for building up the body and also as a source of energy
- Yeasts use acetates as sources of carbon but for most fungi the chief sources of carbon are the carbohydrates (simple sugars)
- Glucose is suitable for almost all fungi and next in preference are the fructose and Sucrose
- The polysaccharides, starch and cellulose are utilised by a fewer fungi which can synthesize the appropriate hydrolytic enzymes
- Less commonly used are the hexose sugars and some pentoses
- Mannitol is equivalent to glucose for many fungi
- Maltose which occurs in nature as a byproduct of starch hydrolysis is utilized by many fungi
- Basidiomycetes include most of the lignin-utilizing fungi
- Some fungi are able to make good growth on fats as the only source of carbon
- Lipids, some organic acids and higher alcohols are utilized by some fungi as a sole energy source of growth

- Fungi require nitrogen through both organic and inorganic materials
- In nature, fungi decompose proteins and peptide or an amino acid to obtain their supply of nitrogen
- The members of Saprolegniaceae and Blastocladiales grow only with organic nitrogen such as amino acid
- In pure cultures amino acids, peptides, or peptones gelatin, casein and egg albumin can serve as sources of organic nitrogen for building up protoplasm
- Urea is also considered as a utilisable nitrogen source for some fungi
- Many fungi, however, obtain nitrogen from inorganic sources
- A number of fungi are known which use both nitrate and ammonium salts

(Example: Absidia sp., Mucor hiemalis, Lenzites trabea and Marasmius sp.)

- Fewer fungi are able to utilize nitrate salts
- Organic sources of nitrogen can also serve as sources of carbon
- Soil inhabiting Rhodotorula and yeast-like Pullularia pullans fix atmospheric nitrogen

- **Hydrogen and oxygen are supplied in the form of water which is the major constituent of fungus mycelium forming about 85-90% of the entire weight**
- **The chief among the inorganic nutrients which the fungi require in fairly large amounts for their mineral nutrition are sulphur, phosphorus, potassium and macronutrients the fungi obtain from simple inorganic salts or sources such as suIphates for sulphur, and phosphates for phosphorus**
- **Some fungi are reported to require only minute traces of iron, zinc, copper, manganese and cobalt and molybdenum in anionic forms**

- **Fungi utilize the vitamins or growth factors in minute amounts**
- **The important fungal vitamins, which may function in enzyme systems include thiamine (B1), biotin, pyredoxine (B6) and riboflavin (B2)**
- **A few fungi also need nicotinic acid and pantothenic acid**
- **The vast majority, however, require thiamine (B1)**

Mechanism of Nutrition in Fungi

- The whole mycelium may have the power to absorb these nutrients or this task may be assigned to special portions of the mycelium.
- In saprophytic fungi the hyphae (Mucor mucedo) or rhizodial hyphae (Rhizopus stolonifer) come in intimate contact with nutrients in the substratum and absorb soluble smaller molecules such sugars and amino acids
- Insoluble complex substances such as proteins, lipids etc. are first broken into soluble monomers (digested) by secreting extra-cellular enzymes and then absorbed
- The mycelium of the parasites is rarely ectophytic but frequently it grows inside the host. The hyphae either ramify in the intercellular space between the host cells or penetrate into the host cells
- The intercellular hyphae of some highly specialised (obligate) plant parasites give out slender lateral outgrowths

- **On the basis of mode of nutrition fungi are classified into four groups**
  - **Saprophytes**
  - **Parasites**
  - **Symbionts**
  - **Predaceous**

Saprophytic Fungi

- Saprophytic fungi obtain their nutrition from dead organic matter
- It may be both animal or plant origin
- The vegetative phase of this fungi directly absorb nutrition required for their growth
- Some species bear special structures for absorption of nutrition called rhizoids
- These fungi mainly produce exo enzymes for release of simple organic matter

They may be of two types

- Ectophytic saprophytes- grow on the surface of organic matter
- Endophytic saprophytes- grow inside the organic matter

Ex. Saprolegnia, Mucor, Rhizopus, Aspergillus, Penicillium, Agaricus etc.

Parasitic fungi

- These fungi take food from other living plants and animals
- The living organisms on which fungi grow are called host
- The growing fungi are harmful to the host as they develop disease conditions in their host
- Such relationship is known as parasitism

- **The parasitic fungi are of three types**

- **Obligate parasites-** essentially require living host, not able to live on dead organic matter

Ex. Puccinia, Albugo

- **Facultative Saprophytes-** These are parasites but can live on dead organic matter when specific host is not available

Ex. Taphrina

- **Facultative parasites-** These are usually saprophytes but under certain conditions they parasitized living host

Ex. Fusarium, Phythium

- **On the basis of location of parasitic fungi in their host they are classified as**

Ectoparasitic- live on outer surface of host (Ex. Erysiphe)

Endoparasitic- grow inside the host tissue (Ex. Fusarium)

- **Parasitic fungi possess specialized absortive structures called haustoria**
- **Haustoria are specialized hyphal midifications**
- **It may be intercellular or intracellular in location**
- **Its size and shape varies in different fungal groups**
- **It may be round, knob like, club like or branched**

Ex. Erysiphae, Phytophthora, Albugo

Symbionts

- These fungi grow on or with living organisms but both of them are mutually benefitted

Ex. Lichen and Mycorrhiza

- Lichens are symbiotic association of algae and fungi
- Mycorrhiza are symbitic association of fungi and roots of higher plants
- It may be ect or endo mycorrization in location

Predacious Fungi

- These are animal capturing fungi
- The fungi possess special hyphal traps called snares which capture small animals like amoeba and nematodes
- These fungi usually inhabit in the soil
- They possess rapid constructing hyphal traps and penetrating haustoria to fatch nutrition from their prey
- Some of them also produce sticky secretions for capturing their prey

Ex. Arthrobotrys, Dactylaria