Fungal Nutrition

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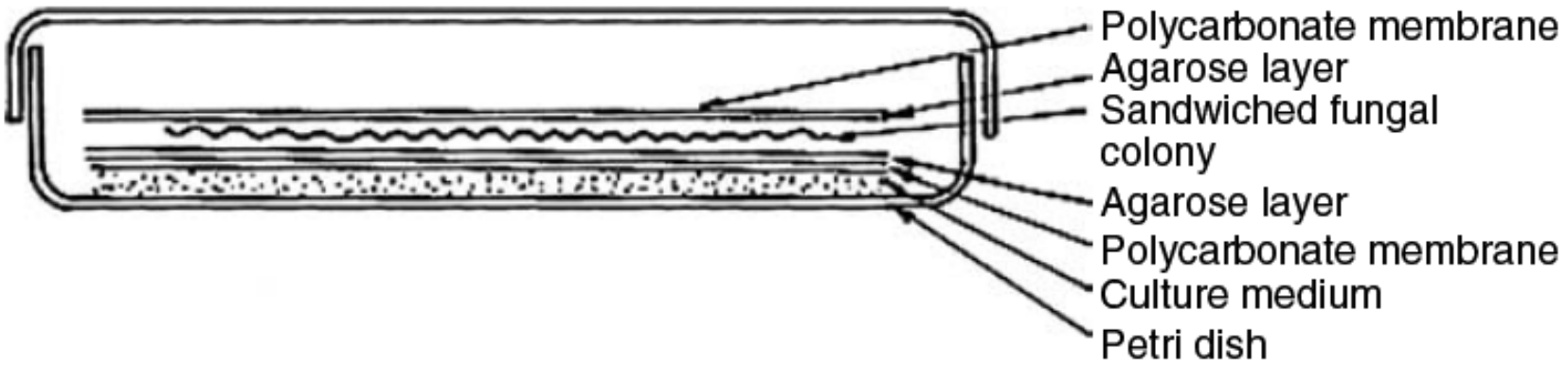
Experiment to show physiological activities along the hyphal length



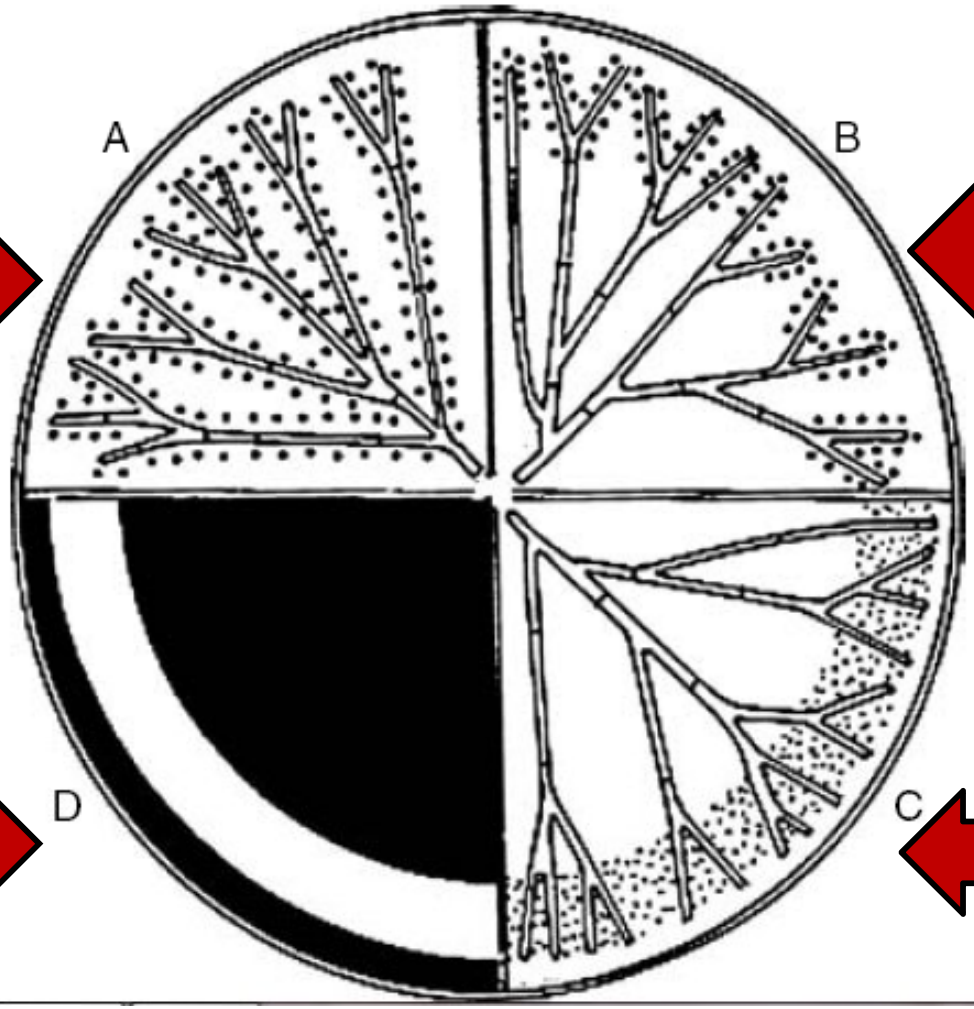
Culturing of *Asperegillus niger* as sandwiched between two perforated polycarbonate membranes placed on starch medium

They used
1.N-acetyl (C14) glycosamine
2. Sulfate (S35)
3. immunogold labeling
autoradiography monitoring of
1. chitin synthesis site.
2. new protein synthesis site
3. glucoamylase secretion
4. zone of starch-degredation activity by IKI stain

Results

Autoradiograph imaging of mycelium for monitoring protein synthesisv

Diagram of zone of starch degradation by I2-IKI staining



Autoradiograph showing chitin cell wall synthesis

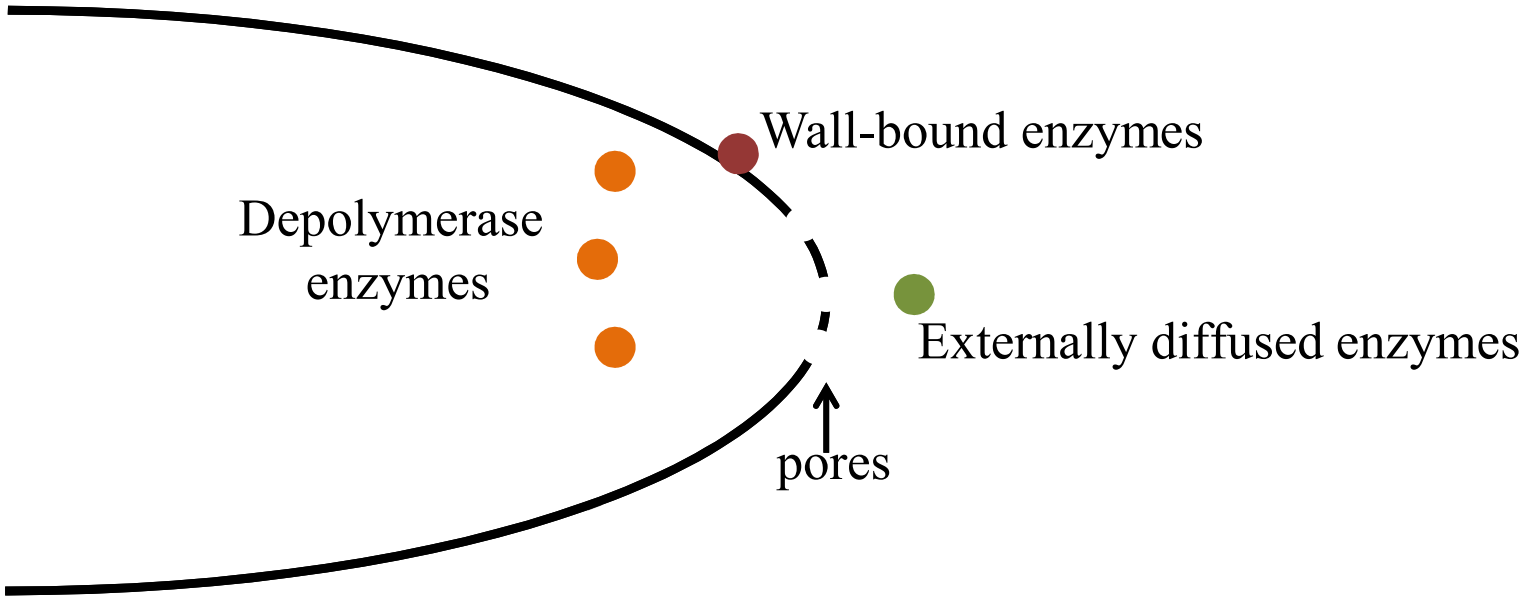
Immunogold labeling showing site of blucoamylase secretion

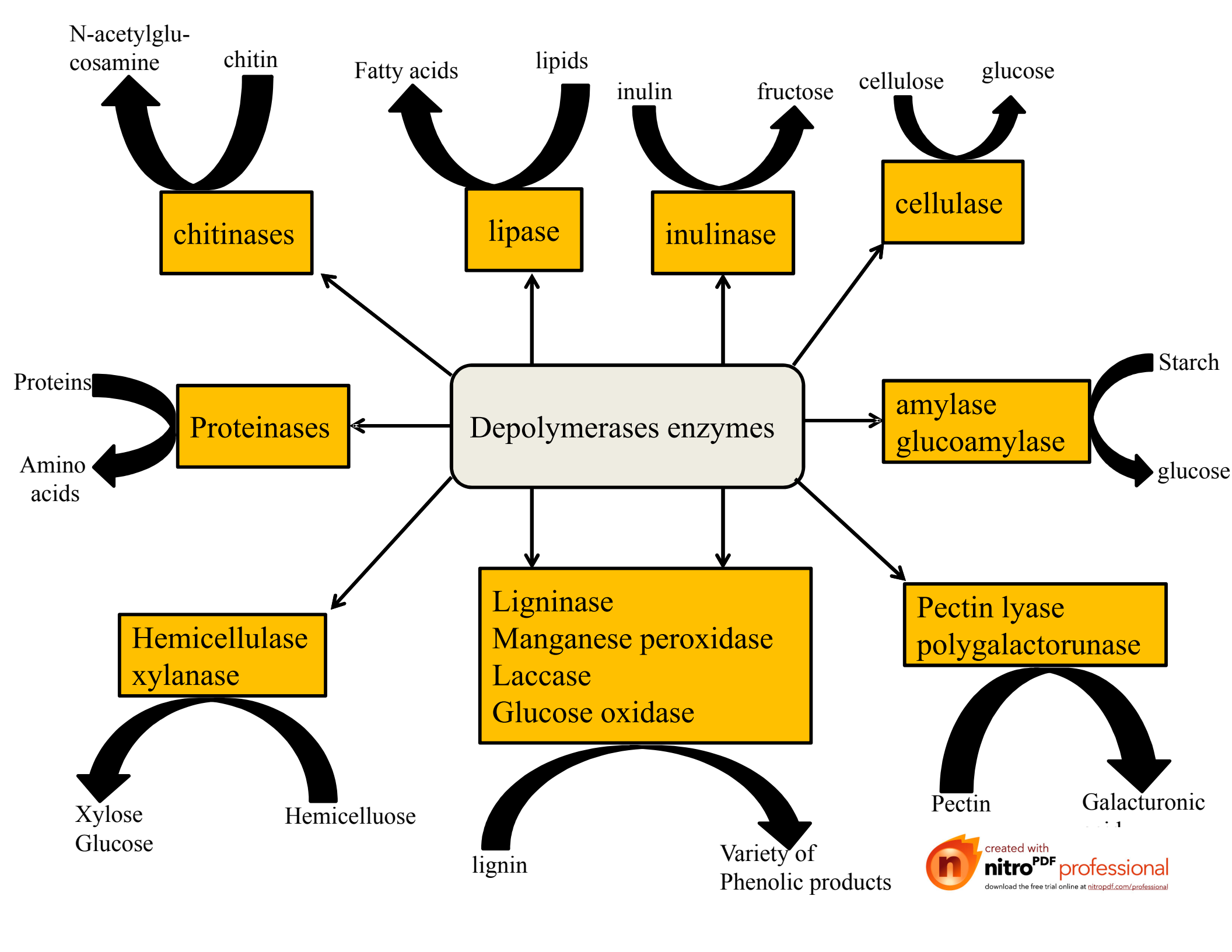
Protein secretion at growing hyphal tip of *Asperegillus niger*.

Protein secretion has been exploited for production of various enzymes on an industrial scale

1. Glucoamylase for glucose syrups
2. Xylanase for paper industries..
3. Proteases for cheese manufacturing.

Enzymes Secretion





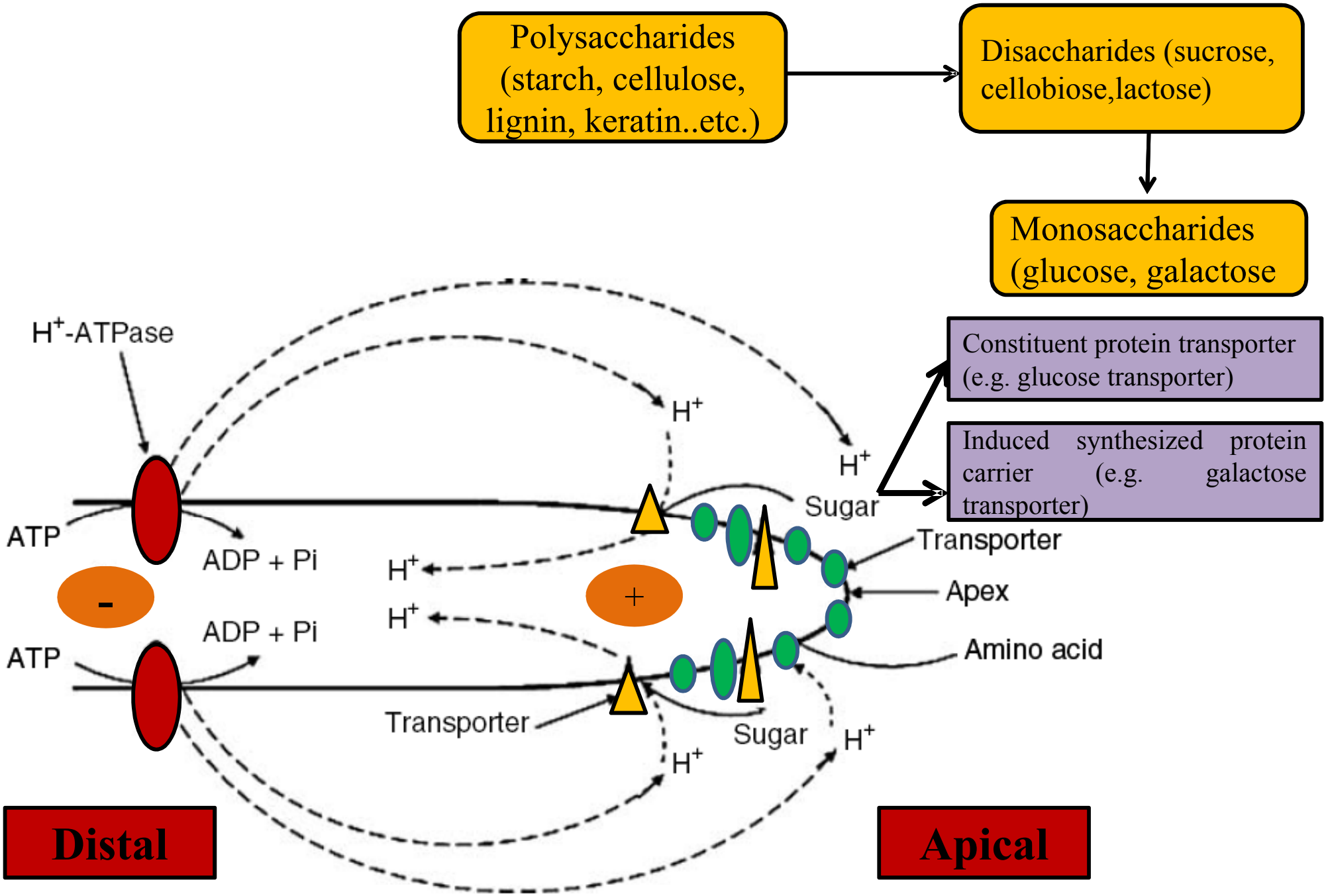


Diagram of proton pump and symport in hypha. Based on Harol

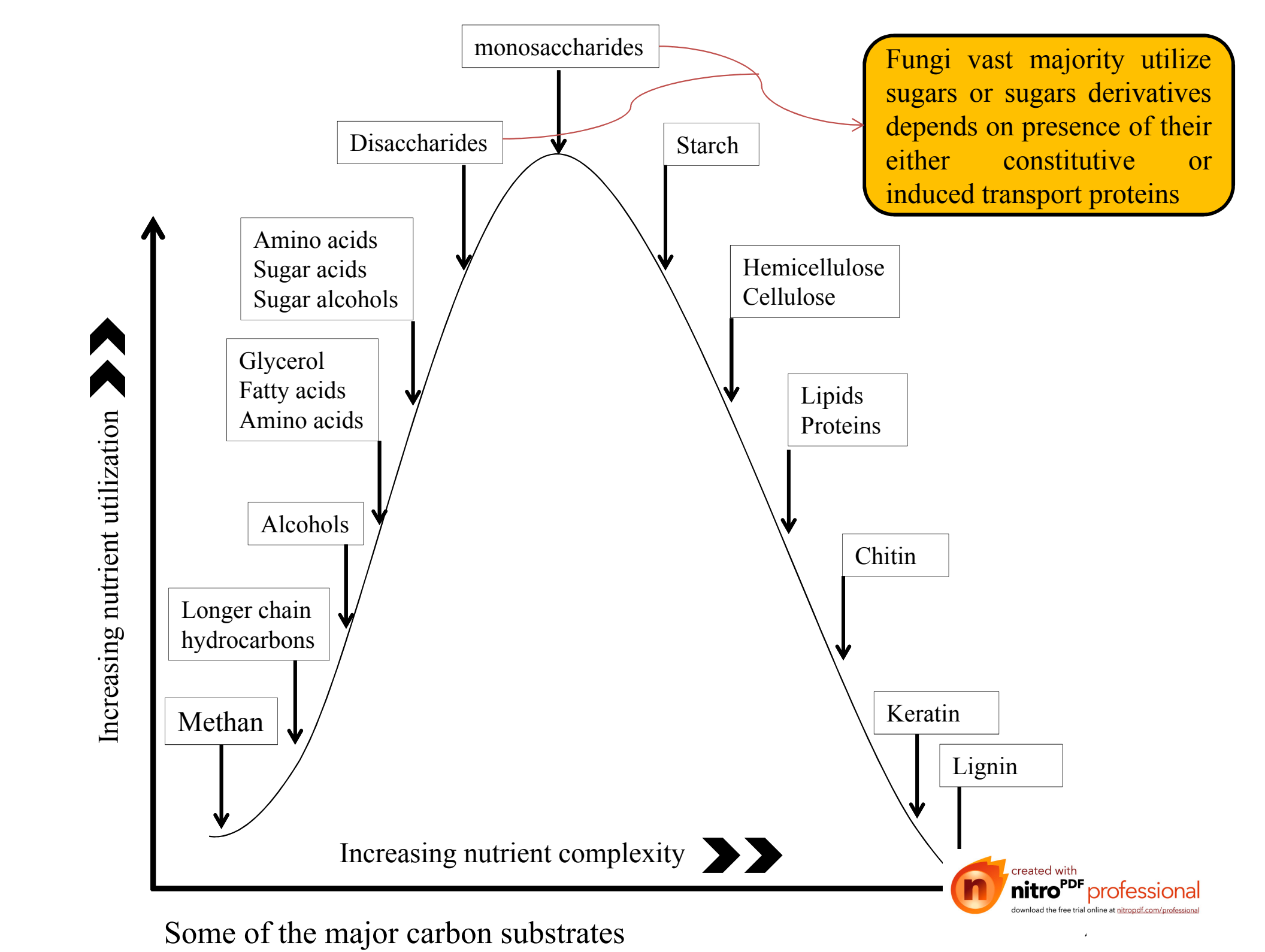
•The hypha drives a current of protons through itself with an inward flow of protons from the tip and their efflux from the distal region.

•The spatial separation of H+-pump and nutrient transport suggest that hyphae not only cytological but also physiologically polarized.

•Hypha secretes a variety of enzymes which break down the polymeric constituents of substratum into simple forms by means of extracellular secreted enzymes.

•The entry of protons is coupled to the active co-transport (symport) of ions, sugars and amino acid.

•The rapid internalization of solubilized nutrients is the basis of the absorptive mode of nutrient

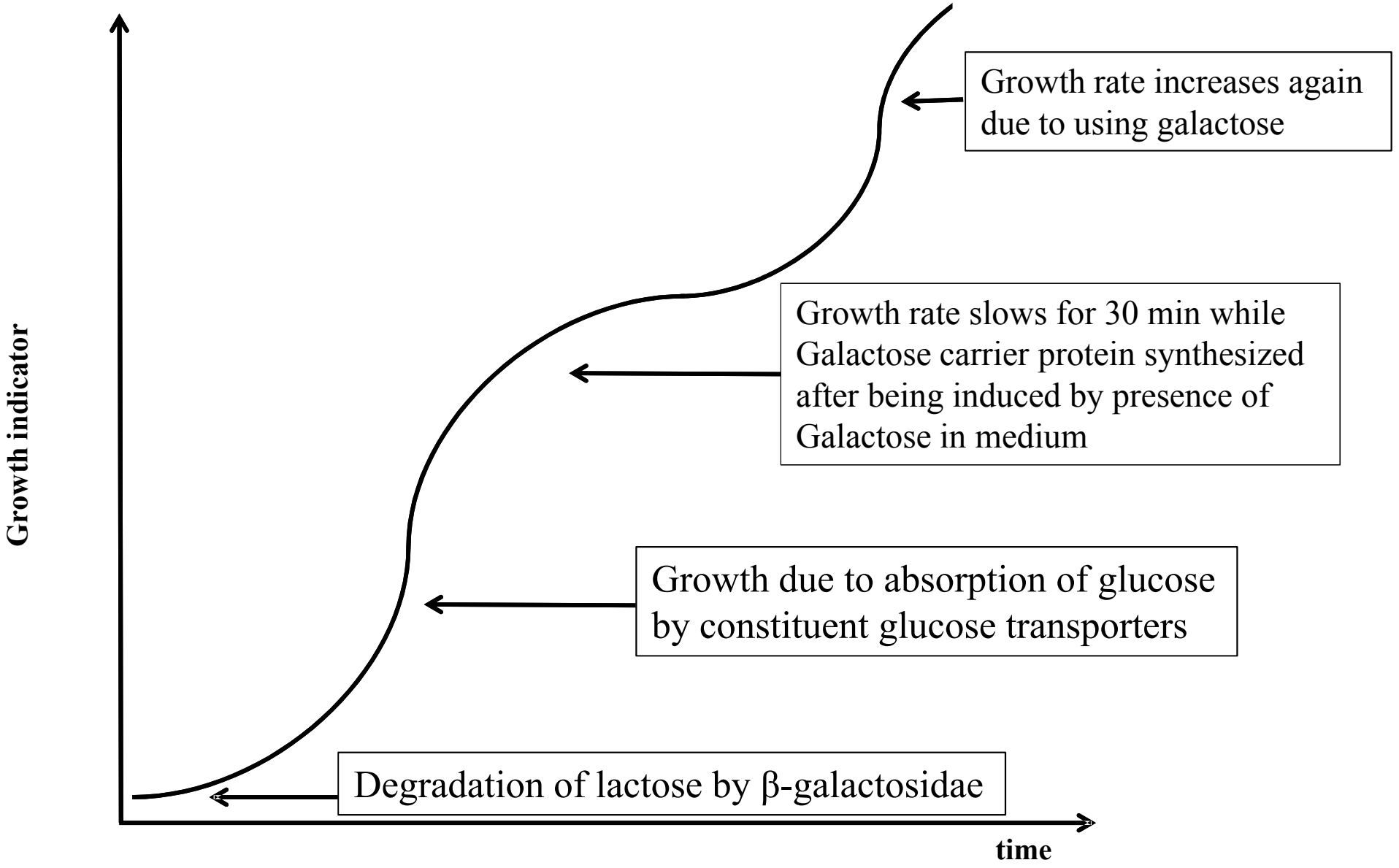


•Fungi exploit a wide range of organic nutrient sources.

•But in all cases they depend on up taken of simple soluble nutrients which can diffuse through wall and enter fungi via specific transport proteins e.g. **Monosaccharides**, **Amino acids** & Small **peptides of 2-3 amino acids.**

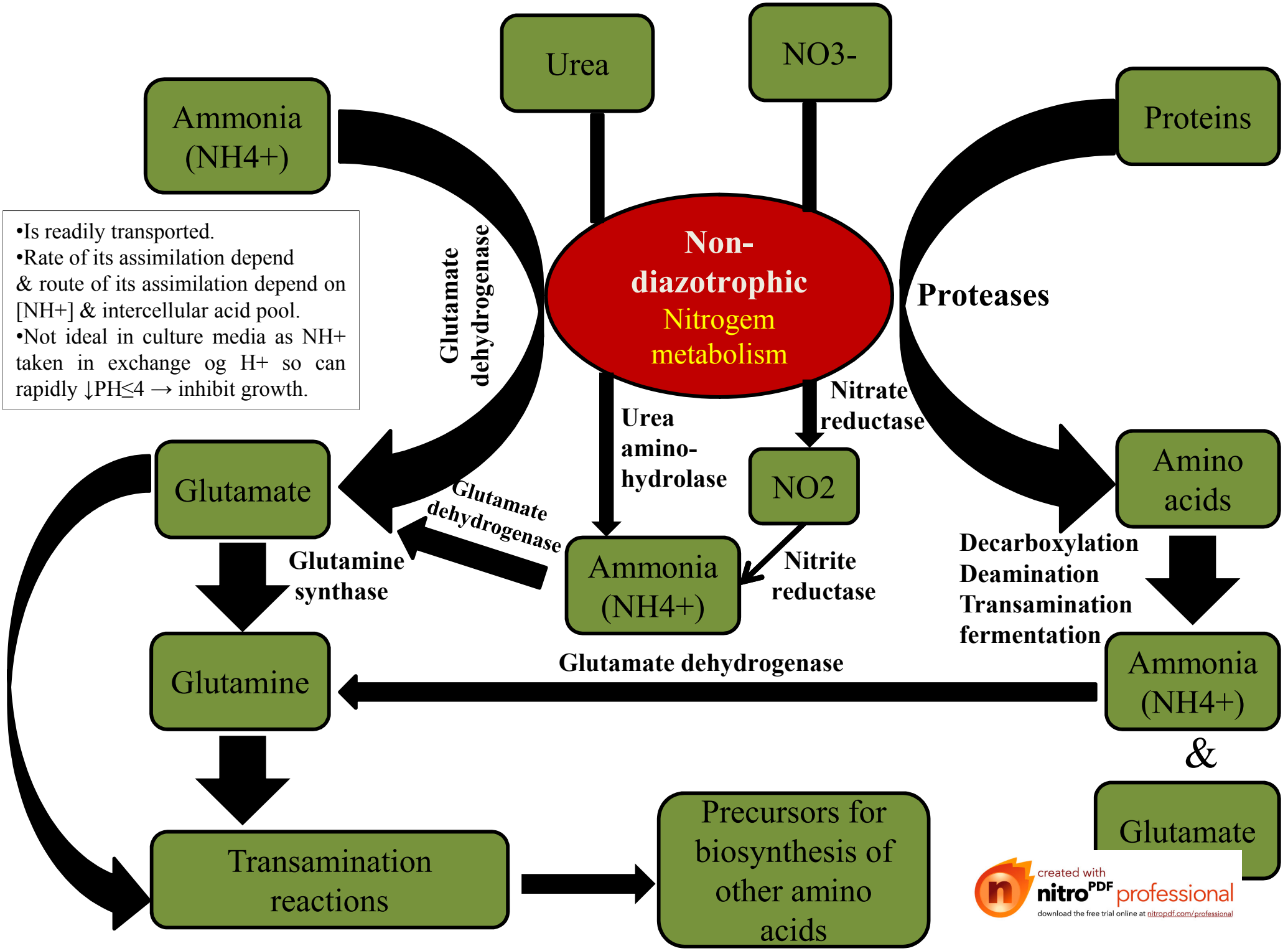
•Even disaccharides e.g. **Sucrose**, **Cellobiose** & **Lactose** have to be degraded into monosaccharides.

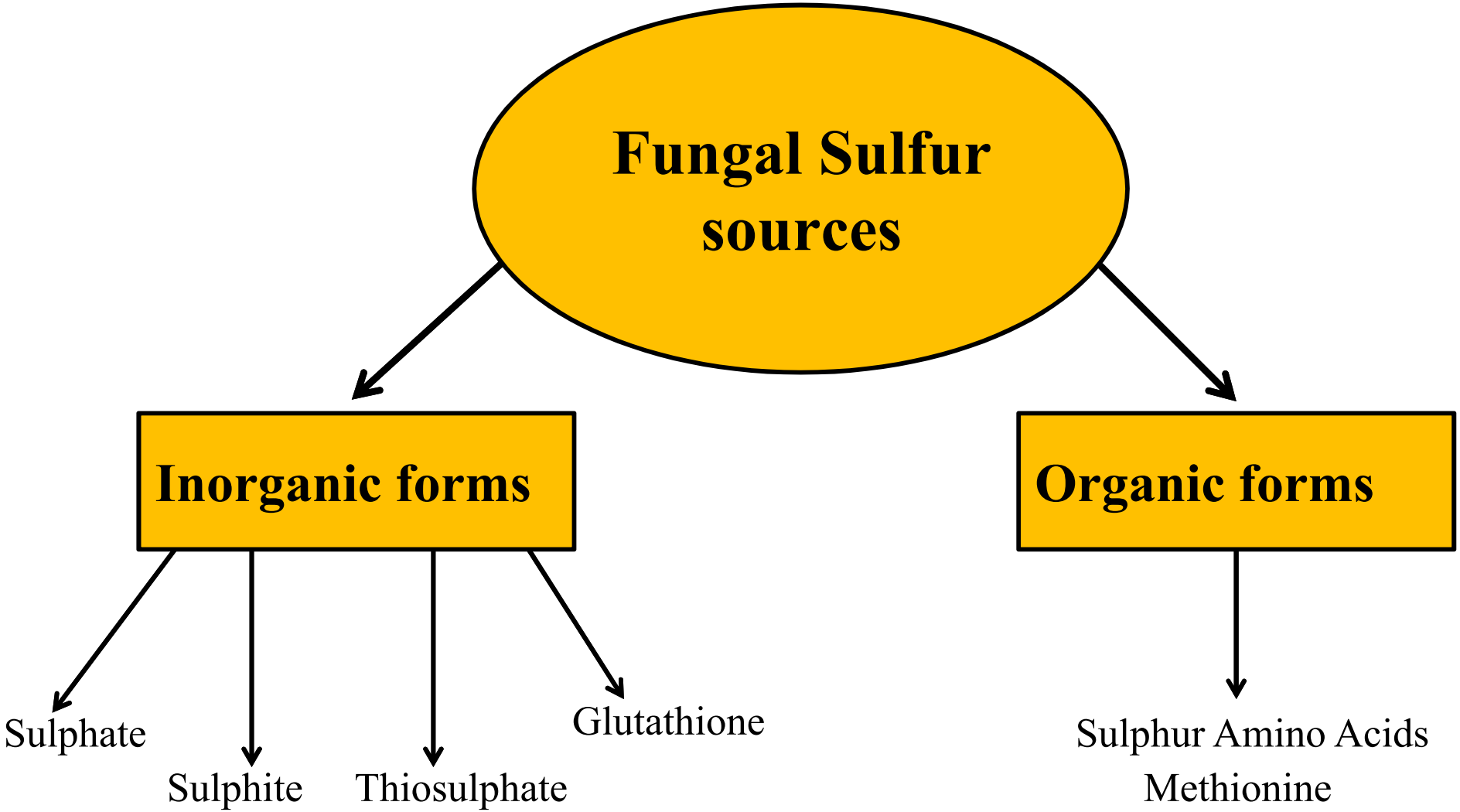
•Larger molecular size substrates have to be broken down by extracellular enzymes (**Depolymerases**) which are secreted by fungus.



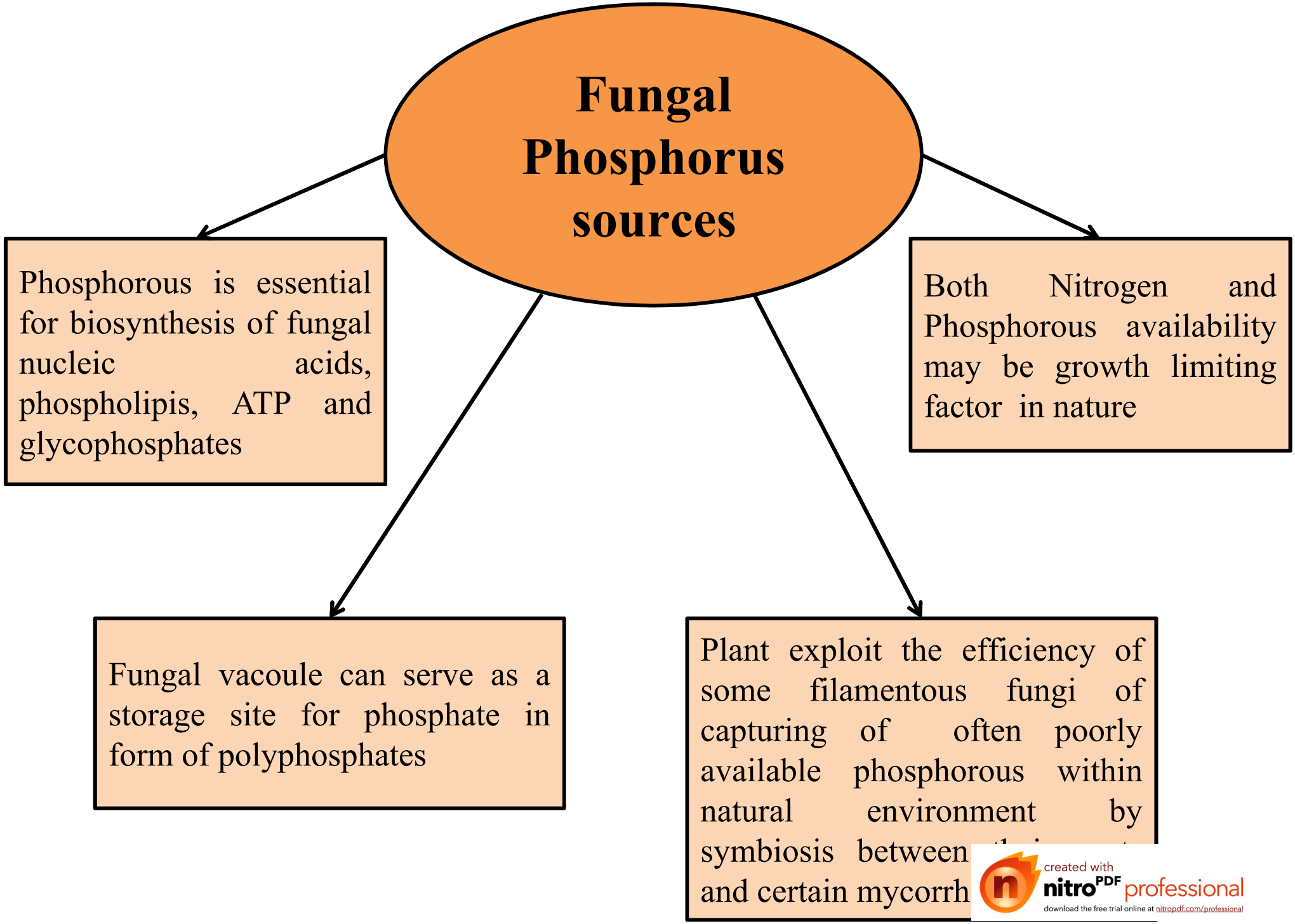
Diauxic growth curve (**Biphasic growth curve**

Growth of *Saccharomyces cerevisiae* on lactose liquid medium





- Virtually all yeasts can synthesize sulfur amino acids from sulphate which is the most oxidized forms of inorganic sulphur



Minerals requirements

Necessary for fungal growth

Microelemnts

Trace elemnts required in micromolar range
Mn, Ca, Cu, Fe, Zn, Ni, Co & Mo.

Macroelements

required in millimolar concentrations
K & Mg

Toxic minerals

Adversely affect fungal growth at concentrations greater than 100 µM
Ag, As, Ba, Cs, Cd, Hg, Li & Pb

Fungal growth factors

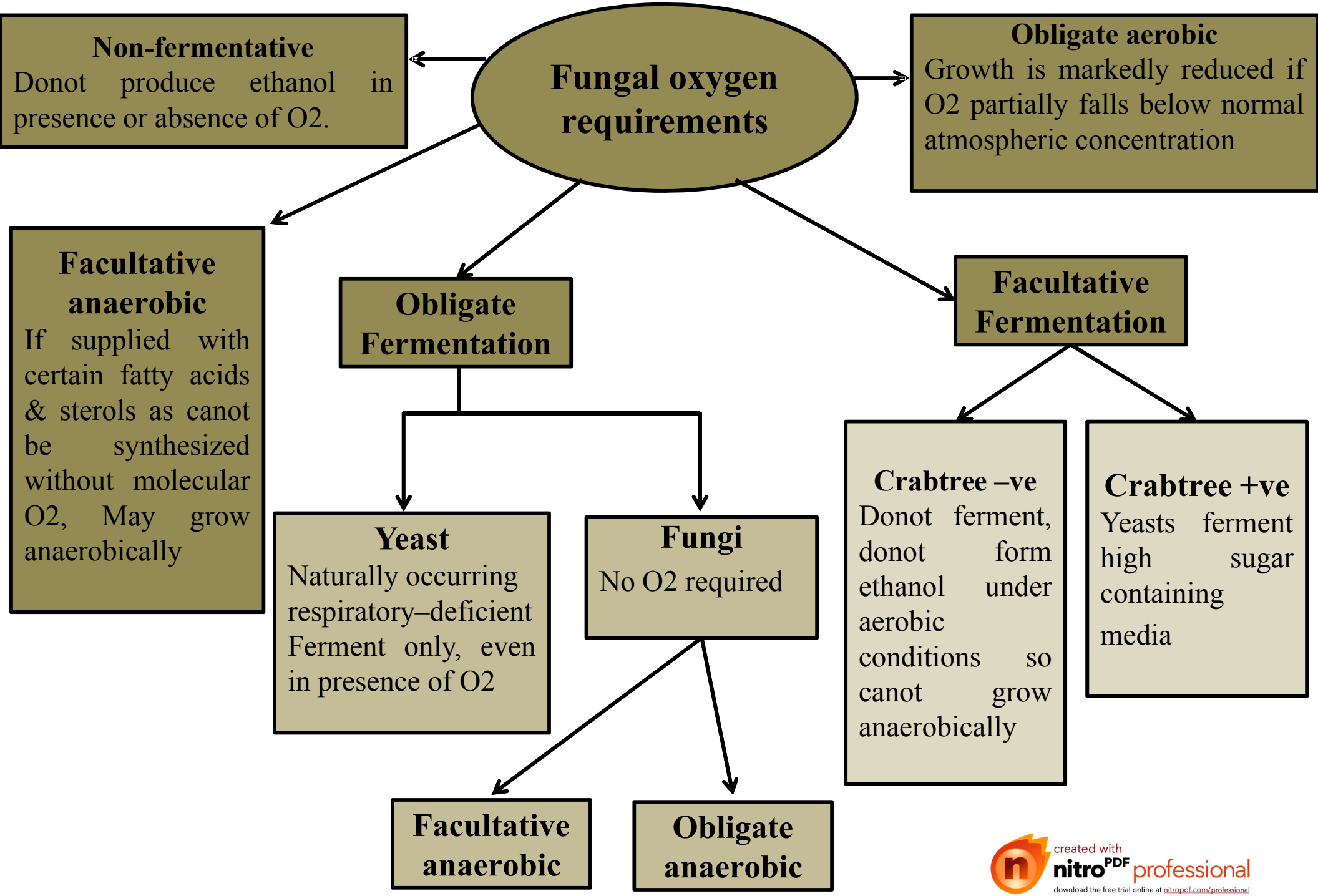
Are organic compounds occasionally needed in very low concentrations for specific enzymatic or structural roles

But Not as energy source

If any one of those growth factors is needed for growth of a fungus so that means it cannot be synthesized by the fungaus.

1. Vitamins
2. Purines.
3. Pyrimidines.
4. Nucleotides.
5. Nucleosides.
6. Amino acids.
7. Fatty acids.
8. Sterols.

Some fungi can synthesize their own growth factors from glucose



Conclusions

- **Oligotrophic**: grow on very limited nutrient supply, even scavenging minute quantities of volatile organic compounds from atmosphere.
- **Chemo-organotrophic**: need fixed forms of organic compounds for their carbon & energy.
- **Non-diazotrophic**: can not fix nitrogen, so have to be supplied by nitrogen containing compounds.
- **Aerobic and facultative anaerobic**.
- **Deploymerase enzymes**:
  - Wall-bound enzymes.
  - Extracellular enzymes.
- Protein transport carriers:
  - Constitutive transport proteins.
  - Induced transport proteins.

Thanks