kigovUnit 8: Applied Mycology (10 Lectures)
Role of fungi in biotechnology; application of fungi in food industry (flavour& texture, fermentation, baking, organic acids, enzymes, mycoproteins); secondary metabolites (pharmaceutical preparations); agriculture (biofertilizers); mycotoxins; biological control (mycofungicides, mycoherbicides, mycoinsecticides, myconematicides); Medical mycology.

Fungi are prominent sources of pharmaceuticals and are used in many industrial fermentative processes, such as the production of enzymes, vitamins, pigments, lipids, glycolipids, polysaccharides and polyhydric alcohols.

During the past 50 years, several major advancements in medicine came from lower organisms such as molds, yeasts and the other diver's fungi.

16 Potential Applications of Fungi

Fungi are extremely useful in making high value products like mycoproteins and acts as plant growth promoters and disease suppressor. Fungal secondary metabolites are important to our health and nutrition and have tremendous economic impact. In addition to this, fungi are extremely useful in carrying out biotransformation processes. Recombinant DNA technology, which includes yeasts and other fungi as hosts, has markedly increased market for microbial enzymes.

Today, fungal biotechnology is a major participant in the global industry due to its mind blowing potential.

1) Designing of vectors

Yeast vectors are used in genetic engineering. E.g., shuttle vectors are used for expression of desirable gene in both prokaryotic and eukaryotic systems. YAC, YRP, YIP, YEP are some other yeast vectors.

2) Fungi as a food

Fungi are used as high cost food because of its high protein and low calorific value. Europe, America, Australia and Japan are very playing industries in mushroom cultivation.

Some of the edible fungi (Mushrooms)are given as below.

Agaricus compestris

Volvariella (paddy straw mushroom)

Morchella (Temperate zone mushroom)

Pleurotus sp. (oyster mushroom)

Agaricus bisporus (white button mushroom)

3) Fungi as a rich source of SCP

Fungi are used as the rich sources of Single Cell Proteins. Some of the fungi for SCP are given as

Yeast (S. cerevisae)

Aspergillus niger

Penicillium chrysogenum

Fusarium avenacum

Neurospora sitoplila

4) Isolation of fungal metabolites of pharmaceutical importance

Aspergillus nidulans and other fungi are used for isolation of secondary metabolites. The secondary metabolites are used as drug. Ergot alkaloids (Ergometrin and Ergotoin) and Lovastatin, a popular cholesterol-lowering drug are the secondary metabolites.

Fungal metabolites have antitumour, antiviral, antibacterial and immunosuppressants activities.

5) Fungal pathogens as nibblers

Fungal pathogens are use as root nibblers to produce many root fibers that increase the maximum uptake of nutrients and water for more yield. Trichoderma viridae and fusarium has shown increased number of root fibres in Tomato & Maize plants.

6) Fungi in improving the quality of produce

It is evidence that some fungal diseases can enhance the nutritional quality of food & feed. E.g. smutted corn and rust infected wheat grains have more carbohydrate and phosphorus contents as compare to healthy plants.

7) Fungi as biofertilizes

Vesicular arbuscular mycorrhizae are the mutualistic symbiosis between the roots of higher plants and certain fungi. The mycorrhizae help in the phosphate nutrition of plants and protect the roots by forming the mantle.

8) Fungi as 'Microbial weed killer '(Bioherbicides)

Fungi are known for its quite specific& effective action and have low residual effects in comparison with synthetic pesticides. Here are given some fungi as bioherbicides. Fungi are used as bioherbicides, some examples with their targets are given in brackets. These are

Septagloeum gillis (Mistletoes)

Wallrothiella arecuthobii (Mistletoes)

Colletotrichum gloeosporiordes(Mistletoes)

Phyllosticta (Glycosmis)

Leptosphaerulina trifolia(Passiflora)

Puccinia chondrillina(Rush weed)

Cercospora ageratinae(Pamakani weed)

9) Cellulose degradation by fungi

Heap of agricultural residues, forest residues deposited ample of celluloses in the soil. Only fungal cellulases are involved in degradation of deposited cellulose. Fusarium, Trichoderma, Penicillium derived cellulases are involved in degradation of celluloses. Degradation of these leads maximum bioenergy production. Some of the other fungal enzymes are gluconase and glucosidase (cellobiase).

10) Bioconversion of lignin

White Rot fungi such as Coriolus versicolor, Polyporus ance and Brown Rot fungi like Poria monticola, Lenzitis trabea are used in depolymerization and degradation of lignin to low molecular weight Petroleum products. These fungi are also used in softening of wood in paper making industries.

11) Entamopathogenic fungi

This group of fungi secretes the toxin, which possesses the entemocidalproperties. The role of entamopathogenic fungi, its products and effects are given as below.

12) Industrial Applications of fungi

Fungi are widely used in fermentative industries for the production of ethanol, organic acids, antibiotics and enzymes like fungal cellulases, gluconase and glycosidase. Certain fungi like P.notatum, P.crysogenum and Cenococcum Sp.are used in antibiotics production where as S.cerevisae and Monilia Sp. are used in ethanol production. Fungi are also useful in ripening of cheese and processing of other products.

13) Biodegradation of pesticides/ Toxic chemicals and petroleum

White Rot fungi have the potential role in degradation of toxic pesticides like DDT, PCB and Lindane. In addition to this, it can degrade certain toxic chemicals like dioxin, benzopyrene, cyanides, azides, CCl_4 and Pentachlorophenol (PCP). Aspergillus, Penicillium, Paecilomyces and Fusarium has found to be involved in petroleum degradation at 30 0C in contaminated soil.

14) Biodegradation of Azo dye and Hydrocarbons

Peroxidase enzyme of Penicillium crysosporium & Streptomyces sps. have potential biodegradable activities that degrade Amaranth dye, Orange G, heterocyclic dyes like, Azure B and Lip dye. The filamentous fungi are also having role in degradation of toxic hydrocarbons.

15) Fungi in Hazardous waste remediation

Fungi help in remediation of explosive contaminated soil by its lignin degrading Enzymes TNT, RDX, HMX are some of the potential explosives that contaminates soil and water. Other degradable nitro explosives by Pleurotus ostreatus are as follows:

Nitrobenzene

4-Nitrophenol

4-Nitroaniline

1-Methoxy 4 nitrobenzene

2-Methoxy 4-nitro phenol

1, 2, di Methoxy 4 nitrobenzene

16) Biomineralization of Heavy Metals

The fungi have eminent role in the removal & recovery of heavy metals from wastewater and industrial effluents. Hg, Cu, Ni, Pb, Cd are extracted at pH 2-5 by myceliar beads of Penicillium.

Conclusion

Fungi are the organisms that have potential role in degradation of explosives. It is observed by repeated laboratory studies involving pure cultures of white rot fungi. It also helps in degradation of hydrocarbons in the environment. Fungi attract considerable attention due to their possible involvement in the diverse applications. So far, large numbers of enzymes have been purified from fungal cultures and characterized in terms of their biochemical and catalytic properties. It possesses antimicrobial activities and is used in biomineralization, as a food for its high protein contents and as a biofertilizers.