For B.Sc. Part I (Hons.) Students (Paper- 1 group B (Mycology and Phytopathology)

ECONOMIC IMPORTANCE OF FUNGI

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Lecture No. 30

➢ Fungi play a significant role in our daily life. They are our greatest friends as well as foes.

➢ Some fungi are prized for their usefulness to mankind, while others are highly injurious as they are responsible for several disease in plants, animals and human beings.

➢ Some important useful and harmful activities of fungi are discussed below

Useful activities

Fungi are beneficial to us, directly or indirectly in many ways. They clean our environment by removing organic dyes; they provide food medicines and several other useful products. Fungi also play role in many industries.

1. Fungi as Food:

Many edible fungi are of great economic value as food. They are regarded as delicacies of the table. There are said to be over 200 species of edible fungi.

Mushrooms: Fleshy fruiting bodies of higher Fungi.

➢ Some mushrooms are edible – contain high amounts of proteins, vitamins, carbohydrates, minerals, dietary fiber , amino acids etc.

e.g., *Agaricus campestris* (Field Mushrooms)

Pleurotus ostreatus (Oyster mushrooms)

Agaricus bisporus (Button mushroom)

Volvariella volvacea (Paddy straw mush room)

Morchella esculenta (Morels)

Tuber melanosporum (Black truffle)

Fungi as Single Cell Protein

Dried biomass of certain fungi are consumed as a protein source.

- Single cell protein (SCP) obtained from Yeast, species of *Aspergillus*, *Penicillium*, *Fusarium*, *Neurospora* and *Candida* is a complete substitute for conventional protein food.
- Quorn , a meat substitute product contain mycoprotein as an ingredient , which is derived from the fungus *Fusarium venenatum.*

Yeasts

Yeast is an Important sources of vitamins B and D complex.

Saccharomyces, Endomyces, Rhodotorula and *Torulopsis* are particularly rich in proteins and hence they are mixed in incomplete livestock.

- A popular food **Sufu** is produced from species of *Mucor* and *Antimucor.*

➢ Some foods like soybeans and cassava although rich in nutrients can not be easily digested by man. These are made easily palatable by fermenting fungi.

➢ Soybeans are fermented by species of *Rhizopus* to prepare temeph , a food which is easily digestible and tasty.

➢ **Incaparina** foods developed by the Institute of Nutrition of Central America and Panama consist of corn(26%), cotton seed flour (38%) , Sorghum (26%), food yeast(3%), minerals and vitamins.

2. Fungi as medicines

Several fungi are used in the production of medicines

(i) Antibiotics : Antibiotics are metabolic substances produced by some living organisms which are injurious to other living beings.

Penicillin - Alexander Fleming in 1944 for the first time extracted the wonder drug Penicillin from *Penicillium notatum* is useful against most of the pathogenic bacteria.

Cephalosporins -produced from the fungus *Cephalosporium acremonium are used to treat respiratory tract, skin and* urinary tract infections.

Cyclosporin: from the fungus *Tolypocladium inflatum is widely used as an* immunosuppressant and greatly improves the success rate of transplant operations**.**

Griseofulvin : produced from *Penicillium griseofulvum* - used to treat infections of the skin, scalp, nails, feet etc.

(ii) Ergot: Ergot is prepared from the sclerotia of *Claviceps purpurea.* It contains some alkaloids which are used to **induce uterine contraction** for abortion, in the treatments of menstrual disorders etc.

iii) Antitumour agents: Shiitake mushroom- (*Lentinula edodes)* contain a polysaccharide lentinan has anti-tumour potential.

Ganoderma lucidum : has polysaccharides that have anticancerous activity

iv) Vitamins: Vitamins are accessory micro-nutrients, which are required by living organisms for their proper growth.

- *Saccharomyces cerevisiae* produce vitamin B complex .
- Synthesis of B-group vitamins by mycorrhizal fungi. The vitamin produced in largest amounts by the mycorrhizal fungi was thiamin (vitamin B1).

➢ **Ergosterol,** a precursor of vitamin D is synthesized by some yeasts and moulds.

(v) Production of Steroids : Steroid like cortisone is produced by *Aspergillus niger from plant* glycosides by fermentation**.**

3. Fungi in Production of Organic acids

➢The important organic acids produced commercially as the result of the biochemical activities of moulds are oxalic acid, citric acid, gluconic acid, gallic acid, fumaric acid, etc.

Citric acid : Produced by fermenting sucrose and molasses by *Aspergillus niger and A. wentii.*

Kojic acid : Produced by the fermentation of sugars by *Aspergillus oryzae*

Itaconic acid : Produced by fermentation of sugars by *Aspergillus itaconium, A. terreus etc.*

Gluconic acid : Produced by fermenting sugars by *Aspergillus niger and Penicillium purpurogenum.*

Fumaric acid : Produced by the fermentation of sugars by *Rhizopus stolonifer.*

Lactic acid, oxalic acid, Succinic acid : Some species of *Mucor, Rhizopus etc. are used in the production of* Lactic acid, oxalic acid and Succinic acid .

4. Fungi in enzyme production

Many intra and extracellular enzymes are found in fungi and some are extracted on commercial scale.

Invertase: Yeasts , *Saccharomyces cerevisiae are used for* the extraction of enzyme invertase which is used to hydrolyse sugars into glucose and fructose . It is used in confectionery and paper industries.

Zymase: Yeasts , *Saccharomyces cerevisiae are used for* the extraction of enzyme Zymase which is used in the preparation of ethyl alcohol by the fermentation of carbohydrates.

Amylase: *Aspergillus niger and A. oryzae are used for the* production of amylase used in alcohol industry.

Cellulase: *Trichoderma reesei is used for the production* of cellulase used in the saccharification of cellulosic and lignocellulosic wastes.

- Fungi are also used in the production of other enzymes like lipases, pectinases , proteases etc.

5. Fungi in Agriculture

Fungi play an important role in agriculture in various ways

Fungi as decomposers :

- Saprophytic fungi secrete enzymes and decompose dead remains of plants and animals . Hence they are called as 'vegetative vultures of Plant Kingdom.'
- During this process, complex organic compounds like cellulose, hemicelluloses, chitin, pectin, lignin etc. are degraded by fungi and produce humus , a nutrient rich material .
- The humus help to maintain the physical and chemical properties of soil, increases soil fertility and promotes various biological activities in the soil.

Fungi as biocontrol agents:

- Some fungi play an important role in the biological control of pests.

Trichoderma harzianum is used to control the blight of tomato. Blight of tomato(caused by *Alternaria solani).*

- *Trichoderma harzianum is* used to control the blight of peanut (ground nut) caused by *Sclerotium rolfsii*

The fungus *Gliocladium roseum is used to control* white mould, *Sclerotinia* diseases.

- *Trichoderma lignorum* suppresses the growth of the root rot fungus *Pythium*.
- Growth of *Rhizoctonia solani* can be checked by *Penicillium vermiculatum*

Fungi in Biological research

Several fungi are used as important research tools for the study of various fundamental biological processes.

- They grow very fast and require a short period to complete their life cycle.
- Experimentation with fungi requires less space and inexpensive equipments.
- ***Neurospora crassa*** *is* used in genetic studies because it is a haploid organism and make genetic analysis simple because recessive traits will be expressed in the offsprings.
- Analysis of genetic recombination (Tetrad analysis) is facilitated by the ordered arrangement ascospores formed after meiosis in the ascus.
- Several strains of ***Aspergillus niger*** have been used as a test organism for determining Mg, Cu, Zn and Mo in soils.
- The slime mold *Physarum polycephalum has been used* as a model organism to study DNA synthesis, morphogenesis, mitotic cycle, amoeboid movement, cell motility etc.

Harmful Activities

There are many fungal activities which are harmful to mankind. Fungi incite many diseases in plants , animals and human beings.

- Fungi cause considerable loss to food, vegetable and fruit crops.
- They destroy valuable timbers and cause spoilage of foodand many other useful articles

Fungi as Pathogen

1. Plant diseases: Most of the parasitic fungi cause diseases in plants, especially in flowering plants. The common fungal diseases of plants are rusts, smuts, mildews, blights, rots and wilts.

Rust diseases: caused by fungi of the order Pucciniales. e.g., Wheat stem rust, also known as black rust, is caused by the fungus *Puccinia graminis.*

Smut diseases: Caused by the fungus *Ustilago.* It mainly infects inflorescence, flowers, anthers etc. The grains get filled with black powder of teliospores of the fungi. e.g. Loose smut of wheat caused by *Ustilago tritici*

Covered smut of Barley - caused by *Ustilago hordei . Grains are replaced by brown-black* balls.

Powdery mildew:

✓ Powdery mildew is caused by fungi of the order Erysiphales.

✓ Infected leaves get covered with a white to gray powdery growth. e.g. Powdery mildew of wheat caused by *Erisiphae graminis*

✓ Powdery mildew of peas caused by *Erisiphae polygoni* .

Blight diseases:

✓Blight diseases are characterized by a rapid and complete chlorosis , browning and death of plant tissues such as leaves, branches, twigs or floral organs.

e.g. Late blight of potato caused by *Phytophthora infestans* , the disease which led to the great **Irish famine**.

White rust of Crucifers

✓ White rust is a disease in plants caused by the fungus *Albugo candida* .

✓ Symptoms include chlorosis on leaf surfaces, white blister like growths on the underside of leaves and on the stems of the plant, and swelling of the roots.

Blast diseases

✓A common disease of paddy , *Oryza sativa by the fungus Pyricularia oryzae.*

✓ Lesions develop on leaf sheaths and on the stems.

✓ The weakened stems are easily broken.

2. Animal diseases

Several fungal species live parasitically on animals and cause various diseases.

Ringworm (*Tinea corporis)*

✓This is a common fungal skin infection that looks like a circular rash.

✓ *Trichophyton*, *Microsporum*, and *Epidermophyton* are the most common genera of fungi that cause ringworm in humans.

Aspergillosis

✓ Aspergillosis is caused by the fungus *Aspergillus.*

✓Symptoms include allergic reactions, lung infections, and infections in other organs.

Candidiasis

✓ Caused by the yeast *Candida*, the most common of which is *Candida albicans.*

✓ Can occur in the mouth and throat, vagina or blood stream.

Athlete's foot

✓ Athlete's foot is a fungal infection caused by *Trichophyton rubrum that* usually begins between the toes.

✓ It commonly occurs in people whose feet have become very sweaty while confined within tightfitting shoes.

✓Symptoms include a scaly rash that usually causes itching, stinging and burning.

✓ This fungal infection is called athlete's foot because it is commonly seen in athletes.

Spoilage of Food stuffs

➢ A large number of food articles, if not properly stored are spoiled by fungi, like *Mucor, Rhizopus, Aspergillus*, *Penicillium* and yeast.

➢ Species of Mucor and *Rhizopus* are commonly seen on the bread and pickle.

➢ Dairy products are spoiled by the species of *Mucor*, *Oidium*, *Torula*, and *Penicillium*

- *Mucor mucedo* and *Rhizopus stolinifer* spoil frozen meat by causing black spot disease.
- Some fungi infect food stuffs even at a very low temperature, *Cladosporium herbaceum* can grow on meat stored at -6 degree Celsius.
- Several species of *Aspergillus, Alterneria* and *Rhizopus* cause post harvest disease in fruits and vegetables thus shortening their storage life.

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Thank You!!!