General MIcrobiology
Lec 11
AIR MICROBIOLOGY

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Ph.D. in Microbial Biology

Microbes Found in Air

- Air is mainly it transport or dispersal medium for microorganisms
- Gases, dust particles and water vapour and air contains of bacteria, fungi and algae, viruses and protozoan cysts.
- **Outdoor microflora: m.o.** found outside the buildings such as *Cladosporium and Sporobolomyces*
- **Indoor microflora: m.o.** found inside the buildings such as *Penicillium, Aspergillus in addition to Staphylococci, Bacillus and Clostridium*

Distrubution of Microorganisms in Air

- Microbes are mostly of soil that have become attached to dried leaves, straw or dust particles, being blown away by the wind.
- More microbes are found in air over land masses than far at sea (spores *Alternaria, Cladosporium, Penicillium and Aspergillus)*
- The dust and air of schools, hospital or rooms of patients with infectious bronchitistubercle bacilli, streptococci, pneumococci and staphylococci have been demonstrated.
- The plant pathogens are also transported from one field to another through air and the spread of many fungal diseases of plants

Sources of Microorganisms in Air

- Air is not a natural environment for microorganisms
- Soil microorganisms when disturbed by the wind blow, liberated into the air and remain suspended there for a long period of time.
- M.O. found in water may also be released into the air in the form of water droplets or aerosols.
- Air may bring the m.o. (commensals or plant or animal pathogens) from plant or animal surfaces into air.
- Human are the main source of airborne m.o. who discharged m.o. into the air by coughing, sneezing, talking and laughing.

microorganisms are discharged out in three different forms

1. **Droplet: usually formed by sneezing, coughing or talking.**

- **consists of** saliva and mucus and contain hundreds of m.o. -pathogenic if discharged from diseased persons.
- The size of the droplet (mostly large) determines the

2. **Droplet Nuclei**

- Small size in a warm, dry atmosphere tend to evaporate rapidly and become droplet nuclei.
- Remain suspended in air for hs or ds, traveling long distances (good source of infection).

microorganisms are discharged out in three different forms

3. **Infectious Dust - Large aerosol droplets settle out rapidly from air on to various surfaces** and get dried (Nasal and throat discharges).

- Disturbance of this dried material by bed making, handling and having dried in the patient's room can generate dust particles which add m.o. to the circulating air.
- M.o. can survive for relatively longer periods in dust.
- Infective dust can be produced during laboratory practices (opening the containers of freeze dried cultures or withdrawal of cotton plugs that have dried after being wetted by culture fluids)

Enumeration of m.o. in air

none of these devices collects and counts all the microorganisms in the air sample tested

1. Impingement in liquids

- In this method, the air drawn is through a very small opening or a capillary tube and bubbled through the liquid.
- The organisms get trapped in the liquid medium and then plated to determine its microbial content.

2. Impingement on solids

- In this method, the m.o. are collected directly on the solid surface of agar medium.
- **Example : settling-plate technique- the simplest**
- In this method the cover of the pertridish containing an agar medium is removed, and the agar surface is exposed to the air for several minutes. A certain number of colonies develop on incubation of the petridish.
- This technique does not record the volume of air actually sampled, it gives only a rough estimate.

3. Filtration:

- **The membrane filter devices are adaptable to direct collection of** microorganisms by filtration of air.
- The method is similar in principle to that described for water sampling.

History of Air Microflora

- 1799: Lazaro Spallanzani attempted to disprove spontaneous generation.
- 1837: Theodore Schwann (support the view of Spallanzani) introduced fresh heated air into a sterilized meat broth and demonstrated that microbial growth couldn't occur.
- 1861:Pasteur showed that m.o. could occur as airborne contaminants.

Air Microflora Significance in Human Health

- Air acts as a medium for the transmission of infectious agents.
- Most of m.o. present in air are harmless saprophytes and commensals AND less than 1 % of the airborne bacteria are pathogens.
- Infection occurs when exposed to a high concentration of airborne pathogens.
- *Staphylococcus aureus is the most commonly*
- found pathogen in air

Air Microflora Significance in Hospitals

- Air of hospital may act as a reservoir of pathogenic m.o. transmitted by the patients.
- nosocomial infections and nosocomial pathogens
- Common m.o. associated with hospital infection
  - *Haemophilus influenzae,*
  - *Streptococcus pneumoniae,*
  - *Staphylococcus aureus,*
  - *Pseudomonas aeruginosa,*
  - *Enterobacteriaceae*
  - *Chlamydia pneumoniae and Mycobacterium tuberculosis*

- As long as m.o. remain in the air they are of little importance but they become beneficial or harmful when transferred.

Significance of Microorganisms in Industries

- **Food manufacture:** Microorganisms that have been transported through the air are involved in various fermentation products (alcoholic beverages, vinegar, dairy products, etc.
- **Spoilage of foods and fermentation products:** M.o. are In industrial processes caused food spoilage when
- Particular organisms are to be grown, to supply sterile air free from contaminating organisms is a considerable problem.

Sources of microorganisms in air

- saprophytic soil organisms raised as dust,
- organisms from body tissues introduced into the air during coughing, sneezing talking, and singing

Airborne diseases are transmitted by two types

(1) Droplet infection proper applies to, droplets larger than 100 µm in diameter.

(2) airborne infection, and applies to dried residues of droplets.

Air Borne Microbial Diseases

- **Pulmonary Anthrax: Bacillus anthracis**
- **Rheumatic Fever: *S. pyogenes***
- **Meningitis : *Haemophilus influenzae***
- **Tuberculosis:** *Mycobacterium tuberculosis*
- **Cryptococcosis:***Cryptococcus neoformans.*
- **Blastomycosis:** *Blastomyces dermatitis*
- **Coccidiodomycosis:** *Coccidioides immitis*
- **Influenza:** *orthomyxovirus.*
- **Measles:** *morbillivirus.*
- **Mumps:** *Mumps virus*

Physical Techniques

A. Dust Control

- Use of dry-vacuum pickup followed by the application of suitable disinfectant detergents solution.
- Oiling floors, bedclothes, and other textiles has proved a highly effective dust control device.

B. Ultraviolet Radiation

- Various types of germicidal lamps (250-260 nm) are used, the most effective bactericidal region.
- These radiations are irritating to human eyes and skin.

C. Laminar-airflow System

- technique recommended for controlling indoor microbial population
- The laminar airflow system is suitable device in electronic and aerospace industries.

Bactericidal Vapours (Chemical Agents)

- Indoor air-borne microbes can be reduced by spraying certain chemical substances into the air such as propylene glycol, triethylene glycol, resorcinol, hypochlorous acid.
- They should be colourless, tasteless, non-irritating, and non-toxic chemicals
- Great care is required for safe and efficient application of chemical agents

Air Sampling
Why do Air Sampling?

- **Verification of ventilation and cleanliness**
  - Establish baseline data
- **Post infection evaluation (outbreak investigation**)
  - Rule out ventilation as a source
  - Discover source of infectious fungi (reservoir)
- **Construction, renovation, repair of certain buildings such as hospitals**
- **Employee complaints**

Microorganisms of the air

Important Facts:

- **Air has no indigenous or native flora**
- **Organisms are found temporarily suspended in air or carried on dust particles or droplets**
- **Air is not sterile**
- **Air does not support the growth of organisms**

Before Microbiological Air Sampling…

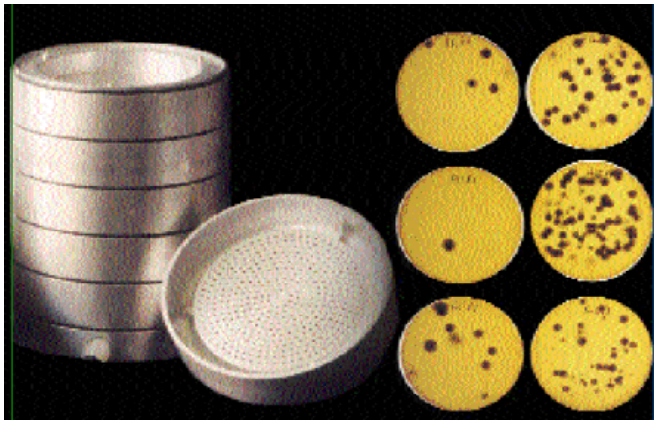
- **Define your objective and analytical approach**
  - Qualitative vs. quantitative
- **Compare indoor results to counts from outdoor air**
- **Fully describe the circumstances in the area where sampling is occurring**
- **High volume sampling most efficient**

Types of Air Samplers*

A.

B.

C.



A. Impactor sampler
B. Glass impinger sampler
C. Sieve impactor sampler

General Control of Air Borne Diseases

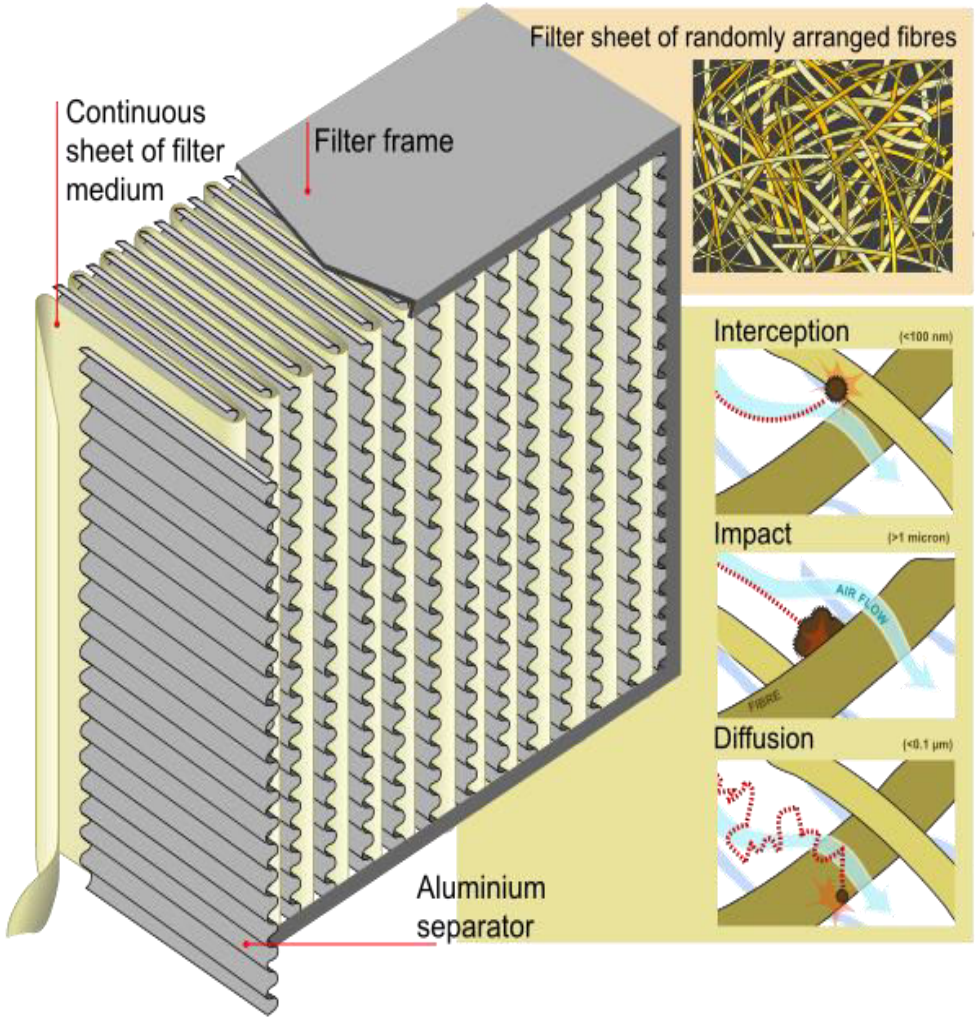
- Good ventilation(dilutes organisms)
- Avoid overcrowding especially in closed places
- Isolation of patients with serious respiratory infections
- Wearing masks
- Spacing of beds or desks
- Disinfect air (HEPA Filters, UV hoods)
- Vaccination

HEPA Filter

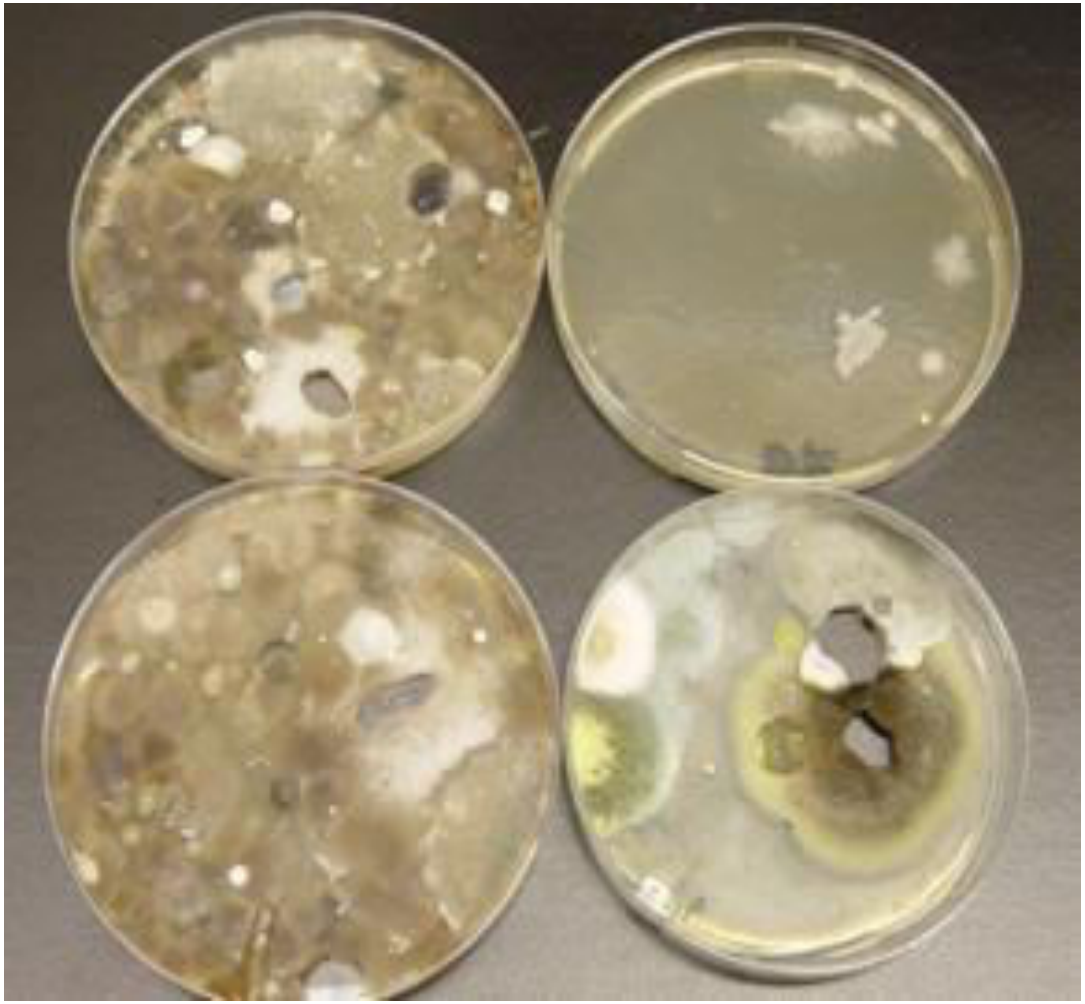
- **High-efficiency particulate air filter**
- It removes 99.97% of all particles greater than 0.3 micrometer from the air that passes through
- HEPA filters are critical in the prevention of the spread of airborne bacterial and viral organisms and infection
- Medical-use HEPA filtration systems incorporate high-energy ultra-violet light units to kill off the live bacteria and viruses trapped by the filter media.

HEPA Filter

- It is composed of a mat of randomly arranged fibers. The fibers are typically composed of fiberglass .
- These particles are trapped through a combination of the following three mechanisms: interception, impaction, diffusion.



Agar plates exposed to Air



Actinomycetes gram stained smear

Gram +ve branching rods