Physical and Chemical Methods for the destruction of m.o in food →

Physical Methods

Control → The term control means the reduction in the number of m.o or their activity to prevent disease and infection as well as to prevent spoilage and deterioration of materials by micro-organisms

- m.o can be killed or reduced or inhibited by physical processes or agents and chemical processes →

Death ⇒ irreversible loss of m.o to reproduce.

Viable ⇒ Capable of reproducing or multiplying

Statis ⇒ not dead, only inhibition of metabolism

Sterilization ⇒ Process of freeing all kinds of m.o (both pathogenic and non-pathogenic).

Disinfection ⇒ Removal of burden (reduction in no.) of mainly pathogenic m.o.

Microbicidal → Agent that kills the m.o completely. Cephalosporin (β-lactam antibiotic)

Microstatic ⇒ Agent that stops m.o from reproducing while not necessarily killing them. ⇒ Chloramphenicol (antibiotic)

How does environment affect controlling of m.o ?

Physical and chemical properties of the medium or substance carrying the m.o is called its environment. It has an importa influence on the rate as well as the efficacy of microbial destruction.

For eg:- • the effectiveness of heat is in acid much greater than in alkaline material.

• the consistency of the material (aqueous / viscous) is also imp: in the control as well as in the penetration of the agent (like antibiotics).

High conc. of carbohydrate generally increase the thermal resistance of organisms

(*) The presence of extraneous organic matter can reduce the efficacy of an antimicrobial agent by inactivating it or protecting m.o from it.

(*) ~~Species~~ Increase in temp of the medium hastens destruct

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Kinds of m.o

Sp. of m.o differ in their susceptibility to physical & chemical agents. Vegetative cells are more sensitive than the spores. Spores are more resistant ~~to~~ under adverse physical and chemical conditions.

Sites where the physical and chemical agents can carry out their actions —

Kinds of Actions

⇒ Damage to the cell wall synthesis
⇒ Alteration of permeability of the cytoplasmic membrane.
⇒ Alteration of physical or chemical state of proteins and nucleic acids.
⇒ Inhibition of enzyme action
⇒ Inhibition of protein or nucleic acid synthesis.

Physical Agents

High Temp.

m.o can grow over a wide range of temp. from very low to high. Low temp are characteristics of psychrophiles while high temp are the characteristics of thermophiles. Each type has an **optimum**, **minimum** and **maximum** growth temp. Temp. above ~~optimum~~ maximum may produce lethal effects while that below minimum will produce **static** ie, the inhibition of metabolism. ∴ may be considered as preservative.

High temp with high moisture is one of the most effective methods of killing m.o.

High Temp

Moist heat

⇒ kills m.o by coagulation of proteins

⇒ Rapid

Dry heat

⇒ kills m.o by oxidising their chemical constituents.

⇒ Slow

Eg) Spores of Clostridium botulinum are killed in 4–20 mins by moist heat at 120°C whereas a 2 hour exposure to dry heat at same temp. is required to kill it.

Thermal Death Time ⇒ Refers to the shortest period of time to kill a suspension of bacteria (or spores) at a fixed temp. under specific conditions.

Decimal Reduction Time ⇒ Time in minutes to reduce the microbial population by 90%.

MOIST HEAT

Steam Under Pressure ⇒ Heat in the form of saturated steam under pressure is an imp. way of sterilization. The lab. apparatus for carrying out this is called **AUTOCLAVE**

Autoclave is a double-jacketed steam chamber equipped with devices which permit the chamber to be filled with saturated steam and maintained at a designated temp and pressure for any period of time. Generally the autoclave is operated at a pressure of about 15 lb/in^2 at 121°C for sterilization of lab equipments, containers etc.

Fractional Sterilization ⇒ Tyndallization - Process where heating of the material at about 100°C on three consecutive days takes place with incubation periods in between. Resistant spores germinate during incubation periods. On subsequent exposure of heat the vegetative cells will be destroyed.

Boiling Water ⇒ General process of sterilization but some bacterial cells can withstand this condition for hours.

Pasteurization ⇒ discussed before.

DRY HEAT

Incineration ⇒ Destruction of m.o by burning is practiced in the laboratory when transfer needle is introduced into the flame of the Bunsen burner.

Low Temp

Low temp. Below the min. temp. of growth depresses the rate of metabolism in m.o

⇒ Refrigeration temp → 4-7°C

⇒ Many bac & virus can be removed by deep-freeze temp. of about -20°C to -70°C.

Liq N_2 at a temp. of about −196°C is used for preserving cultures of many viruses and microorganisms.

Dessication

It causes a total decline in metabolic activity followed by a decline in total viable population.

Factors

1. the kind of m.o
2. the material in or on which m.o are dried.
3. the completeness of the drying process.
4. the physical conditions on which dried m.o are exposed. eg: light, temp, humidity

Sp. of gm-ve cocci such as gonococci are very sensitive to dessication while Streptococci are resistant.

Lyophilization ⇒ where m.o are subjected to extreme dehydration to the frozen state and then sealed in a vacuum. In this condition, dessicated culture of m.o remain viable for many years.

Osmosis ⇒ discussed.

Radiation

Electromagnetic cont. wave / discont. particle } vibrate at diff frequencies

- Ionising radiation
  - Gamma, X-rays rays, Cathode rays
    - When Gamma rays & X-rays pass through cell they create H_2 radicals, hydroxyl radicals and some peroxides which cause intracellular damage.
- Non-ionising
  - U.V rays
    - It is absorbed by most cells. Nucleic a is mainly affected. UV rays forms pyrimidine dimers in which two adjacent pyrimidines become bonded. Unless dimers are removed by specific enzymes, DNA replication can be inhibited & and mutations can thus result.

Surface Tension

The interface between a liquid and gas is characterised by an unbalanced force of attraction between the molecules of the surface of liq and its interior. A molecule at the surface of the liquid - air interface is pulled strongly towards the interior of the liq beneath it. whereas molecules in the interior of the liq. are attracted uniformly in all directions. These molecules ~~are exhibit a specific type~~ forces at the liquid - air surface at the surface of the liquid, known as surface tension.

changes in the surface tension causes changes in permeability of the cytoplasmic membrane causing leakage of cellular substances, which results in damage to the cell.

Filtration => Eg) => ~~Diam~~ Diatomaceous earth, asbestos pad in Seitz filter, Berkefield filter, porcelain in Chamberland - Pasteur ~~field~~ filter and sintered glass disks in other filters.

Biological filters have pores ranging from not one to several micrometers. Porosity is only responsible for removal of m.o. Other factors such as electric charge of filter, electric charge carried out by m.o and nature of fluid being filtered.

Membrane or molecular filters are with microscopic pores of predetermined sizes, composed of inert cellulose esters. These are biologically circular membranes of about 150 μm thickness

HEPA - High Efficiency Particulate Air
=> for filtering air particles