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Factors affecting Fermentation

Pharma Knowledge

Fermentation

- Fermentation is a metabolic process that produces chemical changes in organic substrate through the action of the enzymes using microorganisms.
- **Fermentation can be affected by**
- **Physical factors-** Temperature, pH, osmotic pressure, hydrostatic pressure and radiation.
- **Chemical factors-** Oxygen, carbon, nitrogen, phosphorus, sulfur, etc

PHYSICAL FACTORS

Temperature

- Temperature is the most important factor that determines the rate of growth, multiplication, survival, and death of all living organisms.
- High temperatures may reduce fermentation process because of damage microbes by denaturing enzymes, transport carriers, and other proteins.
- Microbial membrane are disrupted by temperature extremes.
- At very low temperatures fermentation process may also be reduced because membranes of bacteria may also solidify and enzymes also do not function properly.

PHYSICAL FACTORS

pH

- ❖ pH refers to negative logarithm of hydrogen ion concentration.
- ❖ Fermentation process may also be affected by pH because microbial growth is strongly affected by the pH of the medium.
- ❖ If a drastic variations in cytoplasmic pH occurs then it may disrupt the plasma membrane or inhibit the activity of enzymes and membrane transport proteins.

PHYSICAL FACTORS

Osmotic Pressure

- Osmotic pressure is the minimum pressure which needs to be applied to a solution to prevent the inward flow of water across a SPM.
- Solution may be : 1. Hypotonic 2. Isotonic 3. Hypertonic.
- Water activity of a solution
- $\text{Water activity} = \frac{\text{Vapour pressure of solution}}{\text{Vapour pressure of pure water}}$
- Classification of bacteria according to osmotic pressure
- 1. **Osmotolerant** are those microorganisms which can grow at relatively high salt concentration. Examples: *Aeromonas* spp., *Staphylococcus* spp, etc.
- 2. **Halophiles**- Grow in the presence of salt at conc. Above 0.2 to 0.6. Examples: *Halobacterium halobium*

PHYSICAL FACTORS

Hydrostatic Pressure

- ❖ This the force acting per unit area.
- ❖ Classification of bacteria on the basis of hydrostatic pressure are as
- ❖ **Barophiles/ Piezophiles-** Bacteria which grow at moderately high hydrostatic pressures. Examples: Halomonas salaria, xenophyophores, etc.
- ❖ **Barotolerant**—Does not get affected by increased pressure.

PHYSICAL FACTORS

Radiation

- Sunlight is the major source of heat.
- Infrared is the major source of Earth's heat. Ionizing rays can produce mutations which may result in death.
- Visible light is beneficial because it is the source of energy for photosynthesis.

CHEMICAL FACTORS

Carbon

- ❖ Simple to Complex carbohydrates can be added to media in fermentation as a source of carbon.
- ❖ Different sugars like mannitol, sorbitol, organic acids, fatty acids, protein peptides can be added.
- ❖ The selection of carbon source depend upon the availability as well as cost of the material.
- ❖ In most of the fermentation media, crude source of carbon is added.
- ❖ Example of simple carbohydrates are black strap molasses. corn molasses, beet molasses, sulphite waste liquor etc.
- ❖ carbohydrates are starch, corn, rice, potatoes etc.

CHEMICAL FACTORS

Nitrogen

- ❖ Nitrogen source are required for most organelle to synthesize protein, nucleic acid and other cellular compounds.
- ❖ Nitrogen may be provided as a bulk protein, such as Soya meal; as predigested polypeptides, such as peptone or tryptone, or as Ammonia or nitrate salts.
- ❖ Salts of Urea, Ammonia and nitrate can be used as as nitrogen source.
- ❖ When fermentation organisms are non proteolytic in nature pure form of Urea, Ammonia and nitrates are used as a source of Nitrogen.
- ❖ When fermentation organisms are proteolytic in nature, animal and plant raw material is used, like casein, cereal grains, peptones etc.

CHEMICAL FACTORS

Oxygen

- Depending upon the amount of the oxygen required by the organisms, it may be supplied in the form of AIR containing about 21% volume by volume oxygen or occasionally as a pure oxygen requirements are particularly High. The organism's oxygen requirements in may vary widely depending upon the carbon source. For most of the fermentation process, filtered sterilized air is supplied into the bioreactor.

CHEMICAL FACTORS

Water

- ❖ All fermentation process, except solid state fermentation required vast quantity of water.
- ❖ Water is not only a major component of all media but it is important for ancillary services like heating cooling, cleaning and rinsing.
- ❖ A reliable source of large quantities of clean water of consistent composition is therefore essential.
- ❖ Important factor to be considered when assessing suitability of water supply are pH dissolved solids and effluent contamination.

The background of the slide is a dense, repeating pattern of small, light blue water droplets. Each droplet is rendered with a soft highlight and shadow, giving it a three-dimensional appearance. They are scattered across the entire frame, creating a textured, refreshing visual effect.

- Thank You