Lec. 3

 **Fermentation Technology**

 **Row material** : Medium formulation is an essential stage in the design of manufacturing process ., all microorganisms require water , carbon , source of energy , nitrogen , mineral elements and possibly vitamins plus oxygen if aerobic , the medium may also influence pH variation , foam formation , the oxidation reduction potential and the morphological form of the microorganisms it also necessary to provide precursors and metabolic inhibitors ., some microorganisms cannot synthesized specific nutrient , e.g. amino acids , vitamins and nucleotides.

**Water**: water is the major component of all fermentation media and is needed in many of the ancillary services such as heating , cooling, cleaning and rinsing and the quality of water is very important in fermentation processes such as the mineral content of water is very important of brewing , so water may be treated by deionization .

**Carbon sources** : carbon sources are metabolized to formation of biomass or production of primary and secondary metabolites ., the use of cane molasses , cereal grain , starch , sucrose , lactose and glucose as carbon sources . , molasses which are the residue left after crystallization of sugar solution in sugar refining ., molasses is used in production of ethanol , single cell protein , amino acids , organic acids , antibiotics , enzymes , vaccines and microbial gum ., molasses would normally be used as the cheapest carbohydrates to grow yeast biomass in large scale process ., malt from barley grains is the main substrate for brewing beer and lager ., corn steep liquor ( by- product after starch extraction from maize ) and oils may also carbon substrate because costs are competitive with those of carbohydrates ., oils also have antifoam properties ., hydrocarbons such as n – alkanes and methane may be used for production of organic acids , amino acids , vitamins , nucleic acids , enzymes , antibiotics and biomass ., the method of media preparation , particularly sterilization may affect the suitability of carbon for fermentation ., it is often best to sterilize sugar separately because they may react with ammonium ions and amino acids to form black nitrogen containing compounds which will particularly inhibit the growth of microorganisms .

**Energy sources** : most microorganisms are chemo- organotrophs , therefore commonest sources of energy will be the carbon source . , such as carbohydrates , lipids and proteins , some microorganisms can also use hydrocarbones or methanol as carbon and energy sources .

**Nitrogen sources** : most industrially used microorganisms can utilize inorganic or organic sources of nitrogen ., inorganic nitrogen may be supplied as ammonium salts or nitrates ., organic nitrogen may be supplied as amino acids , protein and urea , the growth will be faster with a supply of organic nitrogen ., few microorganisms have an absolute requirement for amino acids ., nitrogen compounds serving as sources of amino acids in additional of vitamins and minerals include soybean hydrolysate , corn steep liquor , soya meal , peanut meal , cotton seed meal , slaughter house waste and yeast extract .

Best nitrogen sources for some secondary metabolites :

Product main nitrogen sources :

Penicillin corn – steep liquer

Riboflavin pancreatic digest of gelatin

Rifomycin soybean meal

Gibberellins ammonium salt

**Minerals:** all microorganisms require certain mineral elements for growth and metabolism ,Mg ,P ,K ,S ,Ca are essential component ,others such as Co, Fe, Mn , Zn are also essential but are usually present as impurities in other major ingredients.

 **Growth factors** : some M.Os cannot synthesize a full complement of cell components and there for required performed compounds called growth factors , such as vitamins, specific amino acids, fatty acids or sterols.

**Other ingredients**: There are another ingredients required for fermentation processes, such as chelating agent , precursors , buffers , inhibitors and antifoaming agent .

 **Fermenter**

**What is a fermenter ?**

A fermenter can be defined as a vessel in which sterile nutrient media and pure culture of microorganism are mixed and fermentation process is carried out under aseptic and optimum condition . Fermenter provides a sterile environment and optimum condition that are important for growth of microorganisms and synthesis of desired product .

A fermenter should be constructed that it can make provisions for the below activities :

1: Cleaning and Sterilization .

2: Temperature control .

3: pH control .

4: Foam control .

5: Aeration and Agitation .

6: Sampling point .

7: Inoculation points for microorganisms , media and supplements .

8: Drainage point for drainage of fermented media .

9: Harvesting of product .

10: Facility of providing hot , cold water and sterile compressed air .

**Major parts of fermenter and their function**

**1: Material used for fermenter :**

It should not be corrosive not add any toxic substances to the fermentation media .

**2: Impellers :**

Impelleres are an agitation device , the important function of an impeller is to mix microorganisms , media and oxygen uniformly .

**3:Baffles :**

Baffles are mounted on the walls of a fermenter , the important function of baffles is to break the vortex formed during agitation process by the impellers .

**4: Inoculation port :**

Inoculation port is a device from which fermentation media , inoculum and substrate are added in the fermentation tank .

**5: Sparger :**

Sparger is an aeration system through which sterile air is introduced in the fermentation tank .

**6: Sampling point .**

**7: pH control device :**

Maintaining pH to its optimum level is very important for growth of microorganism to obtain a desired product .

**8: Temperature control system .**

**9: Foam control device :**

Foam is generated during fermentation , it is necessary to remove this foam with the help of anti- foaming agents .

The design of a fermenter is shown in the following figure :