FACULTY OF ENGINEERING & TECHNOLOGY

Raw materials for industrial fermentation

- All micro-organisms require water, sources of energy like carbon, nitrogen, mineral elements and possibly vitamins, plus oxygen if the process is aerobic.

- On a small scale it is relatively simple to devise a medium containing pure compounds, but the resulting medium, although supporting satisfactory growth may be unsuitable for use in a large scale process.

- The most common microorganisms employed in industrial processes are the **chemo-heterotrophs**. These employ organic compounds as principal source of carbon for energy (ATP) production by using oxygen as acceptor of electron.

- Nutritional factors coupled with essential and trace elements are also required and combined in various ways to form cellular material and products. Fermentation nutrients are generally classified as: sources of carbon, nitrogen and sulfur, minerals and vitamins.

- Raw material for carbon & energy are molasses, Whey, Grains, Agricultural wastes and vegetable oils.

Carbon Source:

▪Carbohydrates and oils, usually the main components of fermentation media, are excellent sources of carbon, oxygen, hydrogen, and metabolic energy. They are frequently present in the media in concentrations higher than any other nutrients and are generally used in the range of 0.2-25%.

▪The availability of the carbohydrate to the microorganism normally depends upon the complexity of the molecule. Sugar beet and sugarcane are the main sources for saccharose and saccharose-rich molasses. The most important starch sources are cereals (corn, wheat, rice), manioc, sweet potatoes and potatoes.

▪Other raw materials used as carbon source are inulin and lignocelluloses, whey and sulphite spent liquor. In particular, the use of lignocelluloses biomass for fermentations is still under research.

▪The nature of the carbon source used as raw material for fermentations depends first on the particular fermentation process as well as the requirements and productivity of the microorganisms. Within the range of suitable raw materials that meet the technological, processing and quality demands of the bioprocess, the raw material price will be crucial.

Nitrogen Source:

Nitrogen is generally the next most important substance in the fermentation media. A few organisms can also use the nitrogen source as the energy source.

Nitrogen and sulfur are part of the organic compounds of the cell, principally in reduced form (aminoacid-sulfhydryl groups).

Some microorganisms are not able to reduce one or both of these anions and therefore, need to be supplied with the elements in the reduced form: nitrogen as ammonia salts and sulfur as a sulfide or as an organic compound like cysteine.

Nitrogen source are corn steep liquor, Soybean meal, Peptones, Yeast extracts, Ammonia and ammonium salts.

Trace elements:

▪Trace elements for fermentation include iron (Fe2+ and Fe3+), zinc (Zn2), manganese (Mn2), molybdenum (Mo2), cobalt (Co2), copper (Cu2), and calcium (Ca2).

▪They serve in coenzyme functions to catalyze many reactions, vitamin synthesis, and cell wall transport. They are required at low levels, can sometimes even be supplied from quantities occurring in water and may contribute to both primary and secondary metabolite production.

▪ Manganese can influence enzyme production. Iron and zinc have been found to influence antibiotic production. It was demonstrated that diphtheria toxin produced by Corynebacterium diphtheriae was drastically reduced by high iron content in fermentation medium due to its induction of diphtheria toxin repressor expression.

▪Like trace elements, vitamins are required in a small amount and are suitable for many metabolic reactions. The vitamins most frequently required are thiamin and biotin. In a greatest amounts are usually niacin, pantothenate, riboflavin, and some (folic derivatives, biotin, vitamin B) are required in smaller amounts. Group B vitamins have been demonstrated to increase lactic acid yield in Lactobacillus paracasei fermentation.