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FACULTY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY

Medium Formulation

- All microbiological media, whether for industrial or for laboratory purposes must satisfy the needs of the organism in terms of carbon, nitrogen, minerals, growth factors, and water.
 - In addition they must not contain materials which are inhibitory to growth. Ideally it would be essential to perform a complete analysis of the organism to be grown in order to decide how much of the various elements should be added to the medium.
 - However, approximate figures for the three major groups of heterotrophic organisms usually grown on an industrial scale are available and may be used in such calculations
 - Carbon or energy requirements are usually met from carbohydrates, notably (in laboratory experiments) from glucose. It must be borne in mind that more complex carbohydrates such as starch or cellulose may be utilized by some organisms.
 - Nitrogen is found in proteins including enzymes as well as in nucleic acids hence it is a key element in the cell. Most cells would use ammonia or other nitrogen salts.
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- Minerals form component portions of some enzymes in the cell and must be present in the medium. The major mineral elements needed include P, S, Mg and Fe.
- Trace elements required include manganese, boron, zinc, copper and molybdenum. Growth factors include vitamins, amino acids and nucleotides and must be added to the medium if the organism cannot manufacture them.
- Under laboratory conditions, it is possible to meet the organism's requirement by the use of purified chemicals since microbial growth is generally usually limited to a few liters.
- However, on an industrial scale, the volume of the fermentation could be in the order of thousands of liters.
- Therefore, pure chemicals are not usually used because of their high expense, unless the cost of the finished material justifies their use. Pure chemicals are however used when industrial media are being developed at the laboratory level.

Criteria for the choice of raw materials used in industrial media

In deciding the raw materials to be used in the production of given products using designated microorganism(s) the following factors should be taken into account.

- (a) **Cost of the material:** The cheaper the raw materials the more competitive the selling price of the final product will be.
- (b) **Ready availability of the raw material:** The raw material must be readily available in order not to halt production. If it is seasonal or imported, then it must be possible to store it for a reasonable period. Many industrial establishments keep large stocks of their raw materials for this purpose.
- (c) **Transportation costs:** Proximity of the user-industry to the site of production of the raw materials is a factor of great importance, because the cost of the raw materials and of the finished material and hence its competitiveness on the market can all be affected by the transportation costs.
- (d) **Ease of disposal of wastes resulting from the raw materials:** The disposal of industrial waste is rigidly controlled in many countries. Waste materials often find use as raw materials for other industries.

(e) Uniformity in the quality of the raw material and ease of standardization:

The quality of the raw material in terms of its composition must be reasonably constant in order to ensure uniformity of quality in the final product and the satisfaction of the customer and his/her expectations.

(f) Adequate chemical composition of medium: As has been discussed already, the medium must have adequate amounts of carbon, nitrogen, minerals and vitamins in the appropriate quantities and proportions necessary for the optimum production of the commodity in question.

(g) Presence of relevant precursors: The raw material must contain the precursors necessary for the synthesis of the finished product. Precursors often stimulate production of secondary metabolites either by increasing the amount of a limiting metabolite, by inducing a biosynthetic enzyme or both.

(h) Satisfaction of growth and production requirements of the microorganisms: Many industrial organisms have two phases of growth in batch cultivation: the phase of growth, or the trophophase, and the phase of production, or the idiophase

Raw materials used in compounding industrial media

The raw materials to be discussed are used because of the properties mentioned above: cheapness, ready availability, constancy of chemical quality, etc.

- **Corn steep liquor:** This is a by-product of starch manufacture from maize. As a nutrient for most industrial organisms corn steep liquor is considered adequate, being rich in carbohydrates, nitrogen, vitamins, and minerals.
- **Pharmamedia:** Also known as proflo, this is a yellow fine powder made from cotton-seed embryo. It is used in the manufacture of tetracycline and some semi-synthetic penicillins. It is rich in protein, (56% w/v) and contains 24% carbohydrate, 5% oil, and 4% ash, the last of which is rich in calcium, iron, chloride, phosphorous, and sulfate
- **Distillers solubles:** This is a by-product of the distillation of alcohol from fermented grain. It is rich in nitrogen, minerals, and growth factors .
- **Soya bean meal:** Soya beans (soja) (*Glycine max*), is an annual legume which is widely cultivated through out the world .The seeds are heated before being extracted for oil that is used for food, as an antifoam in industrial fermentations, or used for the manufacture of margarine.

(e) Molasses: Molasses is a source of sugar, and is used in many fermentation industries including the production of potable and industrial alcohol, acetone, citric acid, glycerol, and yeasts. It is a by-product of the sugar industry. There are two types of molasses depending on whether the sugar is produced from the tropical crop, sugar cane or beet.

(f) Sulfite liquor: Sulfite liquor (also called waste sulfite liquor, sulfite waste liquor or spent sulfite liquor) is the aqueous effluent resulting from the sulfite process for manufacturing cellulose or pulp from wood. Depending on the type, most woods contain about 50% cellulose, about 25% lignins and about 25% of hemicelluloses.

(g) Other Substrates : Other substrates used as raw materials in fermentations are alcohol, acetic acid, methanol, methane, and fractions of crude petroleum.
