

FERMENTATION MEDIUM :

GENERAL INTRODUCTION AND CARBON SOURCE

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By

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INTRODUCTION

- Specific nutritional requirements of microorganisms used in industrial fermentation processes are as complex and varied as the microorganisms.
- Not only are the types of microorganisms diverse (bacteria, molds and yeast, normally), but the species and strains become very specific as to their requirements.
- Most fermentations require liquid media, often referred to as broth, although some solid-substrate fermentations are operated.
- Fermentation media must satisfy all the nutritional requirements of the microorganism and fulfill the technical objectives of the process.
- The nutrients should be formulated to promote the synthesis of the target product, either cell biomass or a specific metabolite.

REQUIREMENT OF MEDIUM

- Nutritional requirement of microbes
- Suitable for technical requirement
- According to end product

WHEN IT REQUIRE ?

- During inoculums preparation
- Propagation step
- Main fermentation medium
- Batch culture

TYPES OF MEDIUM

STATE

- Solid
- Broth or Liquid

PURITY

- Formulated (Defined)
- Raw waste

MEDIUM COMPOSITION

- Carbon source
- Nitrogen source
- Phosphorus
- Sulfur
- Vitamins
- Minerals
- Growth hormones
- Buffer (acidic or alkali)
- Salts – organic or inorganic
- Inducer or inhibitor

NEED OF DEFINED AND COST EFFECTIVE MEDIUM

Defined medium

- For small scale
- Use in laboratory practices
- Use in Research
- Pure chemicals and defined composition
- Product not commercialized

Cost effective raw medium

- For Large scale production
- Use in industrial practices
- Use in large production of goods
- Plant, animal or industrial by product use as raw
- Carbon and nitrogen source not defined
- Product commercialized

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CHOICE OF RAW MATERIAL

- Cost – Need to less
- Viability – Need throughout the year
- Handling – suitable in solid or liquid medium
- Transport and storage – Easy and suitable, cost effective
- Sterilization – easy, do not denature
- Mixing and complexation requirement – suitable for agitation, aeration
- Impurities – need to less

THE CARBON SOURCE

- Biomass is typically 50% carbon on a dry weight basis, an indication of how important it is.
- They serve as energy source.
- Carbohydrates are excellent sources of carbon, oxygen, hydrogen, and metabolic energy.
- They are frequently present in the media in concentrations higher than other nutrients and are generally used in the range of 0.2-25%.

THE CARBON SOURCE : MOLASSES

- Pure glucose and sucrose are rarely used for industrial scale fermentations, primarily due to cost.
- Molasses, a byproduct of cane and beet sugar production, is a cheaper and more usual source of sucrose.
- It is a dark coloured viscous syrup containing 50–60% (w/v) carbohydrates, primarily sucrose, with 2% (w/v) nitrogenous substances, along with some vitamins and minerals.
- Overall composition varies depending upon the plant source, the location of the crop, the climatic conditions under which it was grown and the factory where it was processed.

Warm, fresh molasses churns in the mixing tank



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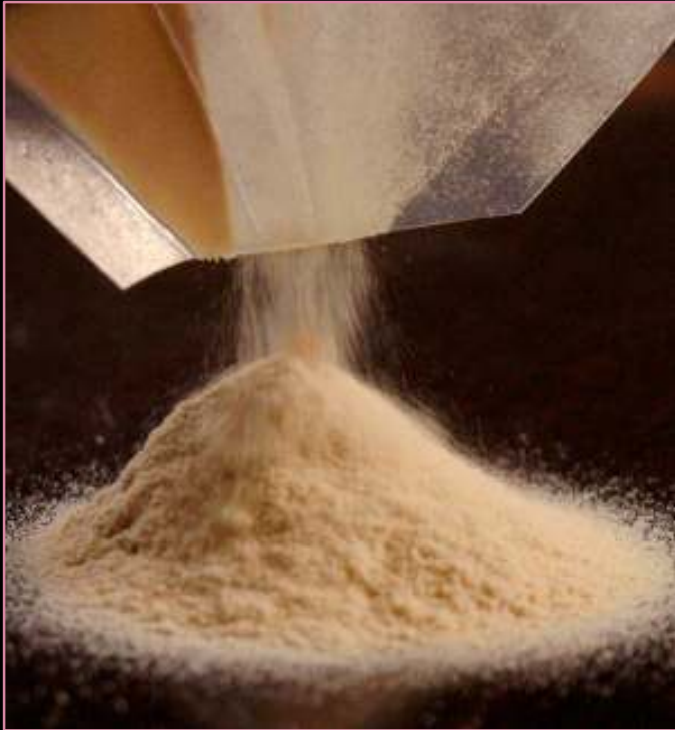
THE CARBON SOURCE : MALT EXTRACT

- Aqueous extracts of malted barley can be concentrated to form syrups that are particularly useful carbon sources for the cultivation of filamentous fungi, yeasts and actinomycetes.
- The composition of malt extracts varies to some extent, but they usually contain approximately 90% carbohydrate, on a dry weight basis. This comprises 20% hexoses (glucose and small amounts of fructose), 55% disaccharides (mainly maltose and traces of sucrose), along with 10% maltotriose, a trisaccharide.

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THE CARBON SOURCE : MALT EXTRACT

- In addition, these products contain a range of branched and unbranched dextrans (15–20%), which may or may not be metabolized, depending upon the microorganism.
- Malt extracts also contain some vitamins and approximately 5% nitrogenous substances, proteins, peptides and amino acids.



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THE CARBON SOURCE : STARCH & DEXTRIN

- These polysaccharides are not as readily utilized as monosaccharides and disaccharides, but can be directly metabolized by amylase-producing microorganisms, particularly filamentous fungi.
- Their extracellular enzymes hydrolyse the substrate to a mixture of glucose, maltose or maltotriose to produce a sugar spectrum similar to that found in many malt extracts.

THE CARBON SOURCE : STARCH & DEXTRIN

- Maize starch is most widely used, but it may also be obtained from other cereal and root crops.
- To allow use in a wider range of fermentations, the starch is usually converted into sugar syrup, containing mostly glucose.
- It is first gelatinized and then hydrolysed by dilute acids or amylolytic enzymes, often microbial glucoamylases that operate at elevated temperatures.

THE CARBON SOURCE : CELLULOSE

- Cellulose is predominantly found as lignocellulose in plant cell walls, which is composed of three polymers: cellulose, hemicellulose and lignin (Bioconversion of lignocellulose).
- Lignocellulose is available from agricultural, forestry, industrial and domestic wastes. Relatively few microorganisms can utilize it directly, as it is difficult to hydrolyse.

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THE CARBON SOURCE : CELLULOSE

- The cellulose component is in part crystalline, encrusted with lignin, and provides little surface area for enzyme attack.
- At present it is mainly used in solid-substrate fermentations to produce various mushrooms. However, it is potentially a very valuable renewable source of fermentable sugars once hydrolysed, particularly in the bioconversion to ethanol for fuel use.

THE CARBON SOURCE : FATS AND OILS

- Hard animal fats that are mostly composed of glycerides of palmitic and stearic acids are rarely used in fermentations.
- However, plant oils (primarily from cotton seed, linseed, maize, olive, palm, rape seed and soya) and occasionally fish oil, may be used as the primary or supplementary carbon source, especially in antibiotic production.
- Plant oils are mostly composed of oleic and linoleic acids, but linseed and soya oil also have a substantial amount of linolenic acid.
- The oils contain more energy per unit weight than carbohydrates.

Thank you

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