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Ph.D. Process & Food Engineering
PFE 606 Bioprocess Engineering
Component of Media

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Lecture

Components of Medium

Basic components of a growth medium

Industrial fermentation media is basically a carefully selected mix of components that can support both microbial growth and specific metabolite production. Water acts as the primary base and temperature regulator, where its mineral profile (such as calcium sulfate or carbonates) significantly influences the quality of the final product, particularly in brewing. Carbon and energy sources, primarily carbohydrates, lipids, or hydrocarbons, are paired with nitrogen sources like inorganic salts and yeast extract. Growth is further optimized through precise oxygen levels, essential macronutrients and micronutrients, and chelators like EDTA that prevent mineral precipitation. The fermentation process is greatly influenced by growth factors (vitamins and amino acids) and metabolic regulators, including precursors that incorporate directly into the product, inhibitors that redirect metabolic pathways, and inducers that trigger the synthesis of specific industrial enzymes.

The above-mentioned components of a growth medium must be supplied in adequate amounts to support the desired cell mass and product yield.

Media Component	Functions
WATER	<ol style="list-style-type: none">1. The major component of all fermentation media.2. Also used for heating, cooling, cleaning and rinsing3. For suitability of a water supply

	<p>it is important to consider pH, dissolved salts (mineral content) and effluent contamination.</p> <ol style="list-style-type: none"> 4. The mineral content of the water is very important in brewing, and most critical in the mashing process. 5. Hard waters containing high CaSO_4 concentrations are better for the English Burton bitter beers 6. While waters with a high carbonate content are better for the darker beers such as stouts.
ENERGY SOURCES	<ol style="list-style-type: none"> 1. Energy for growth comes from either the oxidation of medium components or from light. 2. Most industrial micro-organisms are chemo-organotrophs, therefore the commonest source of energy will be the carbon source such as <ol style="list-style-type: none"> 1. Carbohydrates 2. Lipids 3. Proteins 3. Some micro-organisms can also use hydrocarbons or methanol as carbon and energy sources.
CARBON SOURCES	<p>Commonly used carbon sources are</p> <ol style="list-style-type: none"> 1. Carbohydrates

	<ol style="list-style-type: none"> 2. Oils and fats 3. Hydrocarbons and their derivatives
NITROGEN SOURCES	<p>Most industrially used micro-organisms can utilize</p> <p>Inorganic sources of nitrogen</p> <ol style="list-style-type: none"> 1. Ammonia gas, 2. Ammonium salts 3. Nitrates <p>Organic sources of nitrogen</p> <ol style="list-style-type: none"> 1. Amino acid, 2. Protein or urea. <p>Other proteinaceous nitrogen compounds</p> <ol style="list-style-type: none"> 1. Corn-steep liquor, 2. Soya meal, 3. Peanut meal, 4. Cotton-seed meal 5. Distillers' soluble meal 6. Yeast extract.
OXYGEN REQUIREMENTS	Its availability can be extremely important in controlling growth rate and metabolite production.
MINERALS & CHELATORS	<p>MINERALS</p> <p>All micro-organisms require certain mineral elements for growth and metabolism</p> <p>Macronutrients – concentration $> 10^{-4}$ M (Carbon, nitrogen, oxygen, hydrogen, magnesium, phosphorus, potassium, sulphur, and chlorine)</p> <p>Micronutrients – concentration $<$</p>

	<p>10^{-4} M (Cobalt, copper, iron, manganese, calcium, sodium molybdenum and zinc)</p> <p>CHELATORS</p> <p>The problem of insoluble metal phosphate(s) may be eliminated by incorporating low concentrations of chelating agents into the medium, such as</p> <ol style="list-style-type: none"> ethylene diamine tetra acetic acid (EDTA), citric acid, Polyphosphates <p>The chelating agents form complexes with the metal ions in a medium. The ions then may be gradually utilized by the organism.</p>
<p>GROWTH FACTORS</p>	<p>The most commonly required growth factors are</p> <ol style="list-style-type: none"> Vitamins, Specific amino acids, Fatty acids Sterols
<p>METABOLIC PRECURSORS AND REGULATORS</p>	<ul style="list-style-type: none"> ➤ Used to manipulate the progress of the fermentation. ➤ Regulate the production of the product rather than support the growth of the micro-organism. <p>Precursors</p> <p>When added to certain fermentations, are directly</p>

incorporated into the desired product.

Inhibitors

when certain inhibitors are added to fermentations, more of a specific product may be produced, or a metabolic intermediate which is normally metabolized is accumulated.

Inducers

1. The majority of enzymes which are of industrial interest are inducible.
2. Induced enzymes are synthesized only in response to the presence of an inducer in the environment of medium.
3. Inducers are often substrates such as starch or dextrin for amylases,