Objectives

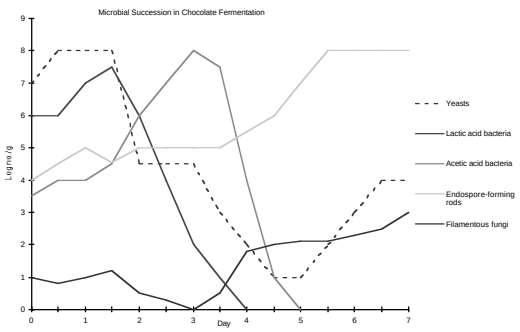
1. Define the following terms: industrial microbiology, biotechnology, fermentation.
2. List the microorganisms most commonly used in industrial processes.
3. Describe the source(s) of microbes in natural fermentations.
4. List an example of each of the following types of cultures: pure culture, succession, consortia.
5. Identify an advantage and disadvantage of each of the following: continuous culture; batch fermentation; solid-state fermentation; immobilized cells.

Definitions

- Industrial Microbiology
- Biotechnology
- Fermentation

World History

- 20,000+ years ago
- 1502
- 1620
- 1849
- 1912
- 1914
- 1939
- Now



Lager:

Starch $\xrightarrow[\text{Malting}]{\text{Germinate}}$ Glucose + Maltose $\longrightarrow$

Ale:

Starch $\xrightarrow[\text{Malting}]{\text{Germinate}}$ Glucose + Maltose $\longrightarrow$

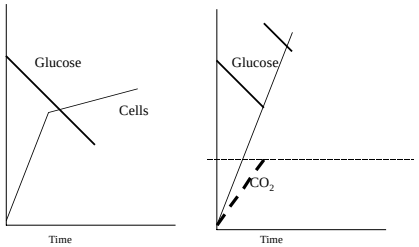
Succession

Sucrose $\longrightarrow$ Ethyl alcohol + CO_2 $\longrightarrow$ Acetic acid

Consortium

Malic acid $\longrightarrow$ Lactic acid

- Primary metabolite
- Secondary metabolite
- Batch fermentation
- Continuous culture
- Fed-batch fermentation
- Solid-state fermentation



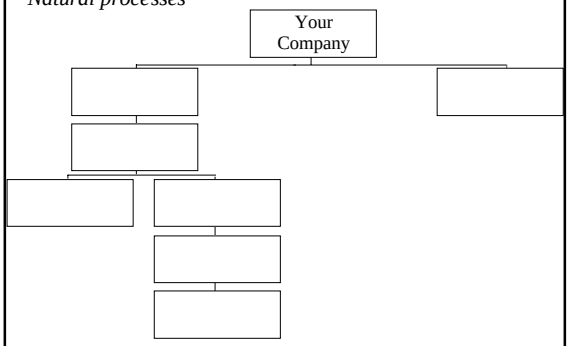
Blue Jeans

- Cotton
- Bleaching
- Sizing
- Dyeing
- Washing

Designer Jeans

- *Gossypeum*
- Chlorine
- Starch
- *Indigofera*
- Soap, water, washing machine

Natural processes



Products

Products Whole Cells

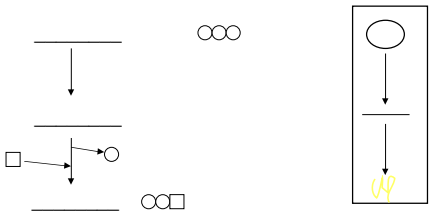
A Problem

- Your lipase-producing strain grows slowly in a small-scale fermenter.
- Yield of lipase, a primary metabolite, is low.
- How can you improve the yield?

Objectives

1. Compare and contrast each of the following pairs:
   a. Natural selection and artificial selection
   b. Selective breeding and recombinant DNA
2. Explain how each of the following is used to improve a product: selection; high-throughput screening; enrichment; mutation; directed evolution.
3. Describe the process of making rDNA using a plasmid vector.
4. List 10 microbial products.

Semi-synthetic products



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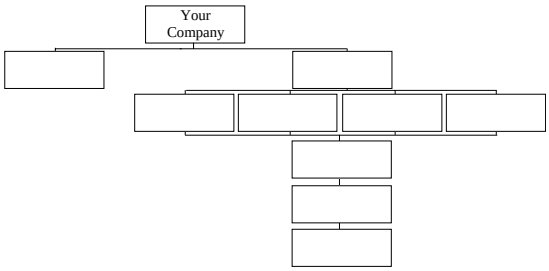


Enrichment

Evolution

Natural Selection

-
-
-

Artificial Selection

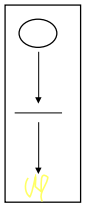
-
-
-
-

Translation

DNA	TAC	TTC	AAA	CCG	ATT
MRNA	AUG	AAG	UUU	GGC	UAA
Amino acid	Met	Lys	___	___	___

DNA	TAC	TTC	AAA	**T**CG	ATT
MRNA	AUG	AAG	UUU	**A**GC	UAA
Amino acid	___	___	___	___	___

Directed Evolution



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-
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Goal is achieved

Selection & Screening

- Select strains
-
-
-
-
-
-
-
- Select mutants

…

Scale-up